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The Man on the Job

THE key position held by the municipal electrical engineer in the development of our industry was perhaps the most important aspect of Mr. P. J. Robinson's presidential address to the I.M.E.A. on Tuesday. The occasion was apt to the subject, as a large proportion of his audience was composed of members of electricity committees representing about 80 per cent. of the local authority undertakings, which in the aggregate produce nearly two-thirds of the electricity supplied in Great Britain.

There is abundant evidence to justify the presidential view that in service to the public the majority of municipal undertakings compare well with companies; they compare very well with those having only limited tenure of their powers. But good is not necessarily good enough; the problem is to bring all undertakings up to the level of the best, such as that managed by Mr. Robinson.

This raises the question as to whether the engineer and manager of a municipal supply undertaking is always given a fair chance to exercise his initiative, the opportunities for which form the chief justification for the existence of relatively small distribution areas. In many instances he is not—quite definitely. His style may be cramped by the deadening effect of specious proposals for joint working with gas in the interests of the latter. He may be discouraged by having to add to his charges to consumers a large and inequitable percentage imposed as local rates, the amount of which varies widely from district to district on no ascertainable principle. Or a false economy may control capital expenditure. Again, a pedantic system of accountancy may intervene to prevent his taking those risks which all concerns meeting a public want have to face if they are to make headway.

These are only a few of the things that are calculated to damp the enthusiasm that is so essential to progress. Beyond these, is the engineer, for example, always accorded undivided responsibility for advising his committee on matters strictly within the proper sphere of his office, such as extensions and tariffs?

One of the most discouraging things in the municipal world just now is the view held by some committeemen that the whole skill in electrical engineering lies in running a generating station, and that distributing engineers (as business managers only, they would say) should be prepared to accept lower salaries. However flattering this assessment of the value of their services may be to station superintendents, it ignores the equally high degree of skill needed in the engineering work of distribution. The combination of the requisite technical knowledge with business ability, the possession of which is more important now than it has ever been, must be paid for on a scale adequate to secure the type of man needed.

The supply engineer should be a booster at the end of the long feeder from the producer to the consumer, but if a niggardly policy of remuneration prevails he may become instead a high-resistance joint. The individual engineer, the man on the job, still counts—and he will continue to count.

Crystal Analysis

THE use of X-rays to detect flaws in welds and castings is common enough, but the even greater possibilities of a newer development remain to be exploited. X-rays differ from light rays only in their shorter wave-length. Their passage through a crystal gives a diffraction pattern in the same way that light waves produce the spectrum, and any change in the

arrangement of the atoms forming the cells (which, in repetition, make up a crystal) varies this pattern. Numerous uses of this method of analysis occur to one, *e.g.*, the composition of boiler scales below the surface, the best settings of jewels for pivot mountings, and the causes of variations in hysteresis loss in transformers and in the magnetic condition of certain alloy steels. An informative pamphlet on the subject has been issued by the Department of Scientific and Industrial Research. Even more to the point is the offer of the National Physical Laboratory to undertake analyses, if necessary at an engineering works, for fees that cover only out-of-pocket expenses. We hope that full advantage will be taken of the opportunity to try this new application of electricity to industry.

Siemens's Cable Business

AFTER a year which yielded returns which were far from satisfactory, Lord Queenborough did not venture an opinion regarding the prospects of Siemens Bros. & Co. for 1934 in his speech at the annual meeting. Though orders are substantially more numerous, prices are low. The most interesting part of the chairman's review related to its cable-manufacturing operations. There were orders for small quantities of submarine telegraph cable for repairing and other uses; important submarine telephone cable work for India and the Isle of Wight was carried out; and schemes for other contracts of this class are under consideration. The Post Office will soon be making substantial additions to the underground telephone cable network of the United Kingdom, a prospect which naturally encourages good anticipations. As a matter of fact, the Siemens plant for the manufacture of underground telephone cable is more fully occupied than it has been for some years, and the signs are that this activity will continue. There was a very low demand for underground power cables during last year, but a number of contracts were carried out for South Africa and other parts of the Dominions.

Mains Rediffusion

IT provides a sidelight on our electrical legislation that if one decides to run additional overhead lines about the streets to relay broadcast programmes one can obtain permission to do so, but one may not use existing mains for the purpose. The "B.I." "electric mains rediffusion" system, which was demonstrated by Capt. P. P. Eckersley at Liverpool on Tuesday, is able to provide three programmes. Theoretically it could give many more, but there are practical limitations to this, the most important being cost, as presumably a purchaser who required a greater range of choice would prefer to buy an independent receiving set. So far as we could see mains-borne and direct radiations cause no interference, and the reception was as good as could be desired. In Holland, we believe, about half the listeners receive their programmes at audio-frequency, which is without many of the merits of the high-frequency system.

Electricity and Trade Revival

THE increased use of electricity by industrial concerns and the installation of new and modernisation of existing electrical equipment are definite signs of general trade revival. Industrialists, too, are much more ready to spend money on equipment where savings in operating costs can be effected, particularly in the coal industry, and nearly always the savings are brought about by electrical means. But perhaps the greater interest lies in the realisation of what can still be done by electrical people for industry as a whole. Many non-electrical drives exist, providing opportunities for us to show how and where savings can be effected, and the biggest and most difficult task in this way is where the loudly voiced claims for "process steam" have silenced electrical men for so long. In new factories recently visited we have seen "electrical process heat" adopted with advantage, and with consequent extension of the electrical drive. Industrial heating offers us an enormous load. Steel-makers have for long talked frankly of the better product provided by the electric furnace, and this modern equipment is fast reaching the stage at which it can compete in cost.

Experience and Imagination

THE thorough survey of the two main outlets for electricity—industrial power and the small household—made in the Convention papers of Messrs. H. C. Lamb and W. E. Swale and of Mr. J. W. J. Townley give just the kind of basic information needed to help the keen load-builder and to resolve the doubts of the super-cautious. The authors define the fields to be covered and show us how to set about the work. The two aspects are more closely related than is sometimes recognised; low domestic tariffs depend upon diversity of use in industry. The insistence of Messrs. Lamb and Swale on the need for specialised power sales departments receives our strongest support.

Local Electricity Research

THE need for something in the nature of a national canvass, or at any rate a survey of the users of electricity by each authority in its own area, is quite obvious to all who study the subject. One would regard it as one of the first duties of a department out to develop a bigger industrial load, to collect information concerning the private plants installed at works and factories in the vicinity of its supply. But it is not done nearly as generally as it should be. Such a census as was taken in Manchester brought together very useful material which is added to by the process of annual revision. No supply authority ought to be content to continue in the dark concerning facts of such a kind relating to either power or domestic conditions. There is obviously great scope for statistical research in electricity supply: its purpose is to afford a useful basis for well-informed canvassing and salesmanship service.

Towards Standard Distribution

NOBODY will dispute the fact that the distribution of electricity is a national question. The main point at issue is whether the public interest will best be served in practice by local or by national control. If the former method is to survive it will be because those responsible can take broad views. Mr. L. Romero's I.M.E.A. paper is the first attempt, so far as we are aware, to collate data relating to the best existing urban practice. While there are considerable divergencies that increase the cost of electricity to the consumer (*e.g.*, the number of voltages and of cable sizes) the investigation shows that there is a marked, if slow, trend towards standardisation in essentials. There is something to be said for "anarchy" in the early stages of development, if the diversity is truly creative and so resulting in a generally agreed standard after the less successful methods have been eliminated—but we cannot afford to wait too long. Cannot the I.M.E.A. itself do something about it?

An Epoch-making Discovery

THE daily Press, in its indefatigable search for some new thing, has discovered an electric heating device of which it publishes vague particulars. Although this "element" is no bigger than a "penny indiarubber" (an elastic criterion), when "suspended in the same way as a microphone" it will heat a room in a few minutes. Where the usual method of heating consumes four or five units every twenty-four hours, the new element will use only one unit. It is stated that it does not even glow, and therefore the inventor has "succeeded in separating light from heat." Applied to a joiner's gluepot the new device did with one two-hundredth part of a unit what a normal element would require one-fifth of a unit to do. The inventor is said to be an archæologist; can it be that he has discovered some long-lost secret of the ancient alchemists?

The I.M.E.A. at Liverpool

Special Reports by "Electrical Review" Representatives at the Convention

LIVERPOOL, Monday Evening.

ANY doubts which I might have had as to whether a large industrial city would prove a popular place for a summer convention were set at rest as soon as I reached here on Saturday evening. On my arrival at the Adelphi Hotel I met the secretary, Mr. J. W. Simpson, who informed me that the number of delegates was over 1,280, about two hundred more than last year, which had established a new record.

While it might be considered that the heavy demand for tickets for the annual dinner on Wednesday was due to the additional attraction of royalty (607 will be present compared with 408 last year and many applicants will be disappointed), this hardly explains the increase in the numbers of delegates who wish to visit works or the receipt of 330 requests for the drive through North Wales on Friday. Usually on that day most delegates, except "the captains and the kings" (meaning by the latter members of the I.M.E.A. Council and the A.M.E.E.) depart.

The weather has so far been what northerners describe as "bracing" (fairly windy with little sun) and some rainfall in the night, but the expectation is that it will be dry under foot. The distance from the Adelphi, which is the headquarters hotel, to St. George's Hall is only about three minutes' walk, and it is a great advantage having the exhibition under the same roof as the conference hall.

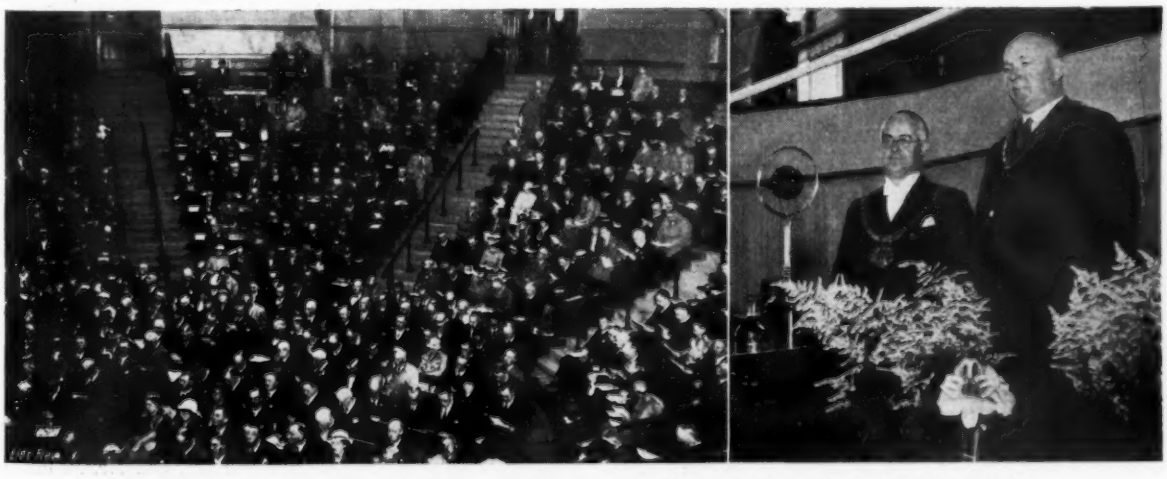
An electrical atmosphere is struck as soon as one comes out of Lime Street railway station at night, as almost opposite is St. George's Hall which is floodlighted by 200 G.E.C. units, 36 of which are of the "Osira" type, which illuminate in blue the areas behind the portico columns of the main frontage and the colonnade of the south front. The 500- and 1,000-W Osram units shine on the main front and the north and south ends of the building, the figured work being singled out for special treatment. The total load is about 130 kW and the general lighting intensity 5 ft.-candles. The Cenotaph also is effectively floodlighted. The Town Hall has been treated in somewhat similar fashion, the vertical surfaces of the tower and the clock faces being illuminated by 1,000-W Osram floodlamps installed on the roof and supplemented by units fitted immediately above the portico. The figure of Minerva which surmounts the tower is lighted by 200-W units.

Even were the Adelphi Hotel not so conspicuous an architectural feature of the city there would be no doubt about its identity in view of its effective illumination by thirty B.T.H. projectors mounted at various angles on a tramway shelter in the middle of the road. "Mazda-Mercra" lamps are used, and their deficiency in red rays is a distinct advantage here, as the slight pink or yellowish tone given to white stone by

Mr. P. J. Robinson, the President, "signs on"

gasfilled lamps is absent and the surface is lightened and seemingly renovated. The capacity of the installation is 12 kW, to which must be added, I should estimate, another 50 kW for the coloured gasfilled lamps set up in the loggia in the middle of an upper storey; these are controlled by a motor-operated dimmer, and make an attractive break in the expanse of white floodlighting.

These installations were carried out by Liverpool Corporation, and will remain in being for the visit of the King next month to open officially the Mersey Tunnel. I noticed that the attention of the public is drawn to these demonstrations, and also to the exhibition, by notices exhibited in the



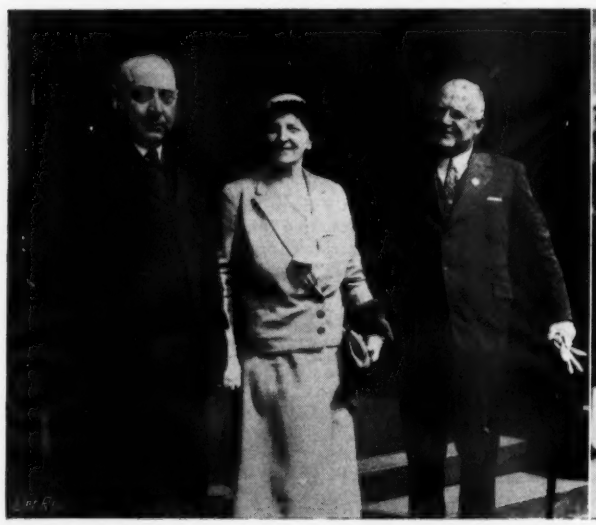
Left: Listening to the presidential address. Right: The Lord Mayor of Liverpool opening the exhibition

tramcars. Incidentally, the modern green 80-seater cars seem to be a notable improvement in every way over the 63- and 67-seater cars of the older type, and it is hardly likely that they will be superseded by any form of buses in the near future.

There are not so many early arrivals this year as there have been when the Convention has been held at the seaside. Mr. V. W. Dale one, of course, expected to find at the end of his strenuous day spent in getting the exhibition ready. There was also Miss Van Schil, of the Antwerp supply undertaking, who hopes to form a counterpart of our E.A.W. in Belgium. Mr. P. J. Robinson, the president, and Mr. E. E. Hoadley, next year's president, both came in on Saturday. I found Mr. Robinson enthusiastic about the high-frequency impulse control of street lamps which he has had under trial since the beginning of the year, and with Mr. P. M. Edinborough, of the Automatic Electric Co., the makers, we discussed some of the far-reaching possibilities of the system which is not limited to the present application.

On Sunday morning Mr. Robinson demonstrated to Mr. Hoadley and myself its working on 360 lamps at Dovecot (there are 30,000 lamps connected on the Liverpool system). He told us that it is inexpensive to install and to maintain, and is accurate and reliable. Calling in at Clarence Dock on the way we had an opportunity of seeing some of the "minor" features of this cheaply laid-out and smooth-running station (which is just now turning out 7½ million kWh per week) for some of which Mr. Robinson gave credit to his technical staff. The subway for "getting the juice away" is one of the many features that should be seen.

We saw some of the municipal housing schemes—excellent examples. In one suburb supply is given from distributors under the eaves, the overall cost of which is less than 25 per cent. of that incurred by underground cables elsewhere in the area. The Hotpoint Co. has an arresting display of domestic appliances in the lobby of the hotel.



Left: Ald. J. W. Nixon and Mr. and Mrs. F. H. Whysall. Right: Sir William Ray with Mr. A. C. Cramb (E.D.A.)

Miss Van Schil (Antwerp); and Mr. Hoadley, the president-elect, with Mrs. Hoadley outside the Convention offices

This morning down to the Convention office to be badged and to meet old friends among the arrivals. A walk round the stands at the exhibition indicates that arrangements are somewhat further advanced this year than they generally are on a Monday morning. Exhibitors with whom I have spoken think it is going to be above the average.

TUESDAY EVENING.

OF last night's function one can only say that it passed off as happily as in preceding years. The delegates and guests were received by the President and Mrs. Robinson, supported by Ald. F. C. Wilson (chairman, Liverpool Electric Power & Lighting Committee), Mrs. Wilson, C.C., and Mr. and Mrs. E. E. Hoadley. Dancing continued until 1 a.m., and everybody appeared to be thoroughly enjoying him or herself.

So great was the number desiring to hear the presidential address this morning that the session was opened at Picton Lecture Hall instead of St. George's Hall. The Lord Mayor (Mr. G. A. Strong) extended a civic welcome to the delegates.

Our general impression of the presidential address was that it expressed the highest co-operative ideals of public electricity supply coupled with a full appreciation of the value of local enthusiasm and a hearty dislike of red tape. A report appears elsewhere, but one needed to have heard its delivery and also its reception to appreciate its full value to the industry as a call to action. Particularly appropriate was Mr. Robinson's reference to the large variety of minds required to foster electrical progress; it is the existence of this variety that gives the Convention its wonderful atmosphere.

Ald. H. B. Vorley and Mr. G. Porter proposed and seconded the vote of thanks. Mr. Porter has temporarily taken over the duties of hon. secretary from Mr. W. C. P. Tapper, who has been in poor health. A familiar figure at these conferences who has not yet put in an appearance is Mr. John Christie, once of Brighton. Mr. L. L. Robinson who has more recently retired from managing the Hackney undertaking is certainly not looking superannuated. Neither is he feeling like it. He tells me that he is working in association with Messrs. May and Hawes as a consultant.

At the close of the presidential address the delegates crossed the road to the exhibition, which was formally opened by the Lord Mayor. Members then had an opportunity of attending a demonstration of the mains wireless rediffusion system, regarding which I heard the prophecy made that it would put the last nail in the coffin of gas as an indoor illuminant. Outside the hall was a collection of battery vehicles by Wingrove and Rogers, Partridge Wilson, G.V. Electric, and Electricars. These looked small by the side of the big E.L.M.A. van, but just as suitable for their purpose.

Electrical Power for Industry

This afternoon's paper on "Developing the Power Load," by Messrs. Lamb and Swale, was read in the conference hall and with the discussion occupied the delegates for two hours. Meanwhile the ladies took tea with Mrs. Robinson in the foyer of the Adelphi. This hotel, by the way, generates its own electricity, the idea being to use the exhaust steam for heating. Like most something-for-nothing arrangements in engineering, this does not quite pan out, and Mr. Robinson told me that after October 1st the supply will be transferred to the Corporation mains.

Caught by our Camera at the Liverpool Convention

1. Mr. C. Pipkin and Ald. A. Upson. 2. Councillor A. J. Fletcher, Mr. V. W. Dale, Mr. and Mrs. E. E. Hoadley, and Mr. J. W. Simpson (secretary). 3. The President's reception. 4. Delegates at the Convention office. 5. Councillor J. W. Clunn, Messrs. C. F. McInnes, W. S. Johnstone and R. Lee. 6. Capt. J. M. Donaldson and Mr. A. P. Macalister 7. Mr. G. Porter. 8. The Lord Mayor and Lady Mayoress receiving delegates. 9. Councillor C. H. Wilkinson, the Mayor and Mayoress of Grimsby, Ald. H. M. Cassels and Mrs. W. H. Thickett. 10. Ald. F. M. Smith, the oldest delegate, studies the REVIEW. 11. Mr. J. Snow Huddleston, Mr. and Mrs. E. K. Muir, Mr. R. W. Smith and Mr. R. C. Harpur. 12. Councillor A. E. Rush and Mr. J. C. Brydges arrive from Eastbourne. 13. At the Convention offices. 14. Mrs. Gregory, Councillor G. J. Stokes and Mr. and Mrs. J. W. J. Townley. 15. Messrs. T. Roles and A. J. Hutchinson. 16. Messrs. A. C. Cramb and L. Romero. 17. Ald. Vorley and Mr. H. C. Lamb. 18. A happy party.

In the course of the discussion on the paper Mr. W. M. Selvey said that in advocating "selling the power idea" the authors had shown what remained to be done, with sly hints as to how the work should be got on with. To obtain prospective consumers the engineer must be well known to those who had the placing of orders. No junior could do that, for one made oneself known in the club and at golf, not by sitting in the office.

Old engines had been developed wonderfully, and large condensing steam engines were still very efficient. But they were nevertheless being displaced because few big machines were being sold nowadays without integral motors to drive them. The price at which electric power was offered was therefore the important factor, and the methods of selling power needed re-examination.

The "high-speed" salesmen of the larger manufacturing organisations had a wonderful technique. There were probably not more than fifty of them in the country, and they were in some respects born to it, not made. If they could be placed at the disposal of the supply industry they would be worth a great deal. The aim should be to sell novelty, something which could not be done otherwise than electrically, and the rest would follow as a matter of course.

Mr. A. Nichols Moore considered the authors' almost casual reference to national co-operation as the most important thing in the paper. It was somewhat disappointing because it concerned itself in an elementary way with the getting of small loads without touching the main problem. If all the privately owned plant could be transferred to public mains, what an enormous difference it would make to the cost of production. That was the principal problem, for low efficiency antiquated mechanical plant was much easier to convert than privately owned electrical plant of high efficiency, low capital cost, and operating under the most favourable conditions. Industrial groups were determined to obtain the lowest prices for energy.

Ald. H. B. Vorley (Islington) said that the power load needed to be much developed especially in the North, where it had to be struggled for, whereas in the South it came more naturally. It should be a base load of great value to everybody. Personal contact was most valuable in connecting the private plant to the mains.

Mr. T. A. G. Margary (Wolverhampton) did not agree that chief engineers should delegate the securing of power load to their subordinates. Chief could meet chief, but subordinates only met their equals, who might lose their jobs if private plant were displaced. Border line cases needed personal attention, and the bigger an undertaking the less personal it became, whereas a small concern could do what it pleased without creating precedents.

Mr. C. G. Richards (Port Talbot) said it was quite wrong to blame supply engineers for not obtaining power loads. Many extraneous factors, such as capital, constant amalgamations, &c., affected the issue and necessitated great care in expending money to afford supplies. Many steam engines in the steel and tinplate industries were now nearing the end of their useful lives; if they could be displaced there would follow quickly large demands for electricity for heat treatment and process work in steel mills. The co-operative element was necessary and low costs would follow the combination (not separation) of industrial and domestic loads consequent on the improved load factor.

Left: Mr. Robinson delivering his address. Right: Outside the entrance to the exhibition

The Secretary (Mr. J. W. Simpson) pins on the President's badge

A Sales Engineer's Text-book

Mr. E. Seddon (Edinburgh) described the paper as a text-book for sales engineers. He had had much difficulty in securing from industrialists proper allocation of expenditure on which to base the price of supply, while special favours could not be allowed between consumers with similar conditions. Even in academical Edinburgh 40 per cent. of the sale of energy was for industrial uses.

Mr. E. T. Williams emphasised the art of securing power loads as the ability to appreciate the user's point of view. Co-operation was the means of reconciling conflicting views. Efficiency need not be worried about, for often quite different considerations decided the issue. Greater facility, utility, and convenience were frequently deciding factors.

Mr. H. C. Lamb (Manchester), in reply, remarked that there was no single formula for obtaining power loads. The personal touch was the central theme, with hard work and careful organisation by capable salesman who had the time

Delegates leaving after the first session

Mr. Lamb tells the delegates how to develop the power load

to keep in touch with prospects. Joint action by industrialists needed countering by joint action on the part of electricity suppliers. Chief administrators could not spare the time for such work, and it must therefore be delegated to competent assistants.

Mr. E. Seddon (Edinburgh) proposed and Mr. G. Porter (Worthing) seconded a vote of thanks to the authors.

WEDNESDAY EVENING.

LAST evening was devoted to the reception by the Lord Mayor and Lady Mayoress at the Town Hall, which was followed by a dance. This morning Mr. Townley's paper on "Electricity Supply to the Small Householder" had a good audience, the E.A.W. being strongly represented.

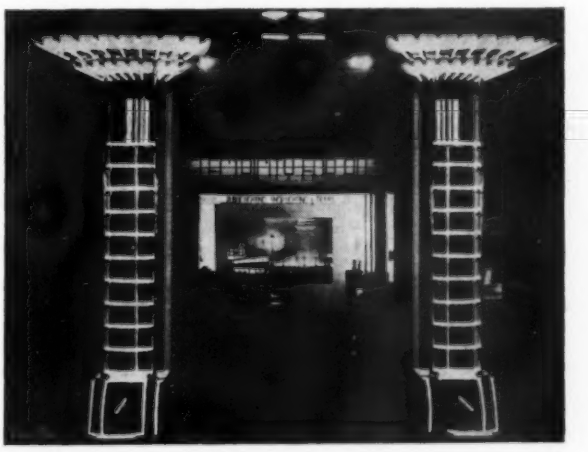
Opening the discussion, Mr. J. N. Waite, Hull, said that the potential small-consumer load was capable of doubling the output and revenue of an undertaking. In Hull this result had been exceeded and its economic value to both consumer and supplier had been proved. A really low charge for price was justifiable because increased use would decrease distribution costs.

Mr. Keay, Housing Director, Liverpool, stressed the necessity of close co-operation between architects and electrical engineers. He looked to engineers to help the organisations to remove the great pall of smoke which hung over great cities and so give city dwellers some of the clean conditions which existed outside cities. Electricity enabled the capital cost, and therefore the rent, of poor class houses to be reduced and thus represented savings to landlords on maintenance and better health to tenants.

Mr. F. W. Purse agreed entirely with the view expressed by the author except in so far as wireless sets were concerned. The author might change his opinion after he had changed over from d.c. to a.c. All engineers could not tackle the same problem in the same way. The small consumer was more valuable than the "high-class" consumer in whose house the cook was the ruling authority and not the housewife. Systematic records should be made in order to provide reliable data which could be published more frequently for the general benefit. The Berry coal-electric system with one fire and a boiler enabled the cost of houses to be reduced by a sum which covered the cost of the electrical equipment.

Councillor G. J. Stokes, West Ham, said they owed a great debt to the author for the audacious manner in which he had handled his Committee. His schemes which had seemed somewhat wild had all proved thoroughly sound. The small demand from a very wide public was more valuable than a high-priced demand from the few. The working class housewife very soon adapted herself to electric cooking.

Mr. L. Romero, Salford, objected to prepayment meter



The entrance to the exhibition in St. George's Hall

assisted wiring schemes contending that they were unnecessary, though admittedly a means of rapidly increasing this class of load. That method gave the impression that electricity was expensive and therefore tended to limit its use. He preferred a straightforward two-part tariff by means of which in his area 10,000 houses of a rateable value not exceeding £15 had already been connected; they were being added to at the rate of 2,500 every year. The 1d. per kWh equated rate was not necessarily the best for industrial towns, though it might be useful in London.

Mr. E. E. Hoadley, Maidstone, commented on the fact that three years ago he estimated £20 per annum as the lowest rateable value house which would be useful. The author had now shown how false was that prediction. There was no lower limit to the rateable value of the house which could be electrified. He agreed thoroughly that the commercial relation between supplier and consumer should be as simple as possible. The reason why they were now succeeding so rapidly was that they were becoming psychologists rather than pure engineers.

Alderman J. Scott, Bootle, considered that the electrical industry would have to face much more severe gas competition in the future, because all the willing electrical consumers had already been obtained. The remainder must now be persuaded to change over. A rate of 1d. per kWh for all domestic purposes except lighting, with assisted wiring and free maintenance by means of a small rental, had enabled them to secure

The floodlighting of the Adelphi Hotel, the Convention headquarters

70 per cent. of the existing small premises in 2¼ years. There had been no objections which indicated that satisfactory service was not given. The cost of the prepayment meter almost equalled the cost of the installation. Cheaper meters were very desirable.

Mr. A. J. Hutchinson, Farnworth, said that the paper showed how the younger engineers were at last putting a kick into development. Such simple rates as 1d. per day per light sounded good and were readily acceptable, although the consumer paid just the same as anyone else. Wash-boilers were also an excellent device to encourage; their diversity was good and they were steady consumers.

Mr. W. J. Jones, E.L.M.A., suggested that every undertaking should make a plan of campaign, so that all potential consumers could be connected within a reasonable time. At least half of the new connections made last year were new houses so that much remained to be done with old property. It was very desirable to speed up the process. Mr. G. Wilkinson, Harrogate, considered that some of the methods of determining the fixed part of a tariff were uneconomic. He preferred to base the charge on the maximum demand and called attention to the great value of thermal storage both for water heating and for cooking which would have an important influence on distribution costs.

Mr. W. A. Gillott, English Electric Co., pointed out that the reason why greater progress was now being made was because they were now operating on lines which were understood by the masses, coupled with simple tariffs. The smaller consumer wanted a "pay as you go" system—a slot meter or similar method. Mr. F. Newey, of Lincoln, described the paper as marking a definite step forward in the evolution of tariffs for the masses.

Mr. J. W. J. Townley said that the discussion had now involved him in writing another paper in reply. One could not get business by means of tariffs, which were merely theoretically sound; it must be obtained in some other way. They had to do many things not because they liked to do them, but because they brought in business, particularly in new housing areas. His methods were, of course, not applicable to all areas. They must encourage people to look upon electricity as fashionable and other services as out of date. If the cost of converting wireless apparatus was so large, as it had been said, why was the change-over made? If it cost too much it could not be economic, but in each case he had had to deal with, the change-over had justified itself over a period, notwithstanding the cost of adapting wireless, medical and dental installations.

Mr. T. Roles, Bradford, in moving a vote of thanks, said that he could confirm from his own experience the author's statement that each cooker resulted in an added 1,000 kWh per year. The author had shown that good engineers could also be commercial men. Miss C. Haslett, E.A.W., in seconding the vote of thanks, promised that her Association would do its best to support the author's ideas. Now that slum clearance was receiving so much attention the suggestions contained in the paper were of extreme value and importance.

Visits to Liverpool Works

In the afternoon alternative visits were offered to the Prescot works of the B. I. Co. and to the Strowger and Broad Green works of the Automatic Electric Co. The former was described in our last issue. About 350 people took part in this visit; Mr. A. J. MacPhail's "museum" probably attracted as much interest as anything. At the Strowger works the automatic telephones are made by about 4,000 employés, providing one of the biggest power loads for the Corporation. The smaller Broad Green works was of most interest to the women visitors as there "Xcel" cookers and fires are made.

While delegates were thus occupied the Duke of York was being shown round Clarence Dock, from where he went on to the exhibition. His arrival in Liverpool just after 2 p.m. was signalised by an aeroplane urging from the sky: "Fly and Use Electricity," the two most significant features of our age.

Those who have managed to find time to go to New Brighton have seen the large swimming pool, for which Messrs. A. E. Chesters of that town have provided a fine electrical installation which includes 300 lighting points (30 kW), 24 flood-lighting points (20 kW), and 12 points for under-water lighting (6 kW), besides heating and cooking equipment of 40 kW, pumps and other power uses. All wiring is in copper conduit with galvanised iron fuse-boxes and switches. Much of the cable is Henley's "Superite."

There was a record attendance at the luncheon of the Electrical Association for Women held at Reece's Restaurant, there being nearly 350 present. They were addressed by Mrs. F. C. Wilson, president of the Liverpool branch, Mr. E. E. Hoadley, and Miss Haslett. Miss Haslett emphasised the point in Mr. Robinson's address regarding the need for the installation of electrical equipment in schools in order to impress the electrical idea upon the young mind.

Sir William Ray, executive chairman of E.D.A., seems to be everywhere at once. This is the first opportunity he has had of meeting the municipal supply people in the mass and he is certainly taking full advantage of it to make himself known and to get acquainted with the leaders of this important section of the industry. He is to deliver an address to the Liverpool Rotary Club to-morrow (Thursday).

Delegates are looking forward to this evening's dinner which, graced by the presence of the Duke of York and Lord Derby, should be a brilliant affair.

Among Those Present

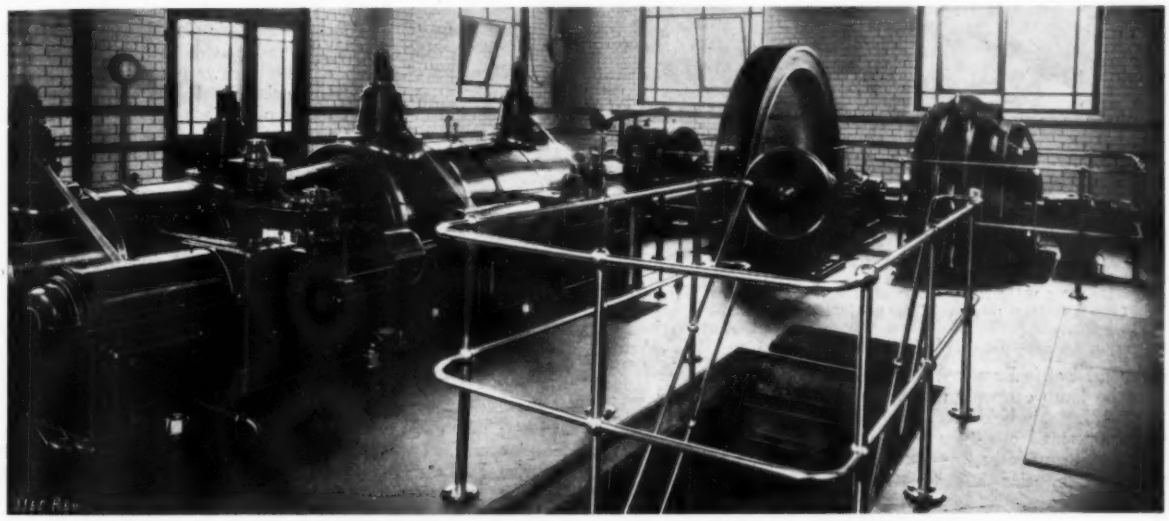
The official list of members and visitors attending the Convention contains 1,176 names. Among these are the following well-known members of the electrical profession and industry:—

A. J. Abraham (Bexley Heath); D. G. W. Acworth (G.E.C.); H. Adam (Seaham Harbour); J. E. Adam (Paisley); W. E. Affleck (Guildford); Cdr. F. J. C. Allen (Bastian and Allen); S. T. Allen (C.E.B.); R. Amberton (Elec. Apparatus Co.); E. A. Anderson (Walton and Weybridge); J. Anderson (Bellis and Morcom); E. Andrews (Mexborough); H. W. Angus (Eccles); H. E. Annett (Bolton); C. L. Arnold (M.K. Electric); A. Aspinall (Brighouse); L. B. Atkinson (C.M.A.); R. Ayton (Winchester); W. J. Bache (Cheltenham); E. F. Bacon (Holmfirth); A. W. Barham (Watford); E. A. Barker (Barnsley); J. A. T. Barnes (Kendal); F. G. Batt (G.E.C.); Capt. A. J. Beckett (Bridlington); J. Beckett (Municipal Tramways & Transport Association); W. E. W. Beerling (Brit. National Electrics); Maj. H. Bell (Glasgow); J. Alex.

The Council of the Incorporated Municipal Electrical Association

Bell (Aberdeen); C. R. Belling (Belling & Co.); H. H. Berry (Berry's Electric); G. J. Berry; R. Berry; W. C. Bexon (Ayrshire Elec. Bd.); S. F. Bickell (Falk, Stadelmann & Co.); A. Bishop (Buxton); D. H. Bishop (Dundee); H. Bishop (Falkirk Iron Co.); H. E. Blackiston (Ipswich); A. S. Blackman (Sunderland); G. M. Blackmore (Stanley); R. Blackmore (C.E.B.); A. W. Blake (Willesden); A. V. Bland (Chamberlain & Hookham); T. Bloore (Sutton Coldfield); F. A. Bond (Battersea); Ald. Sir P. Bower (Birmingham); J. M. Bowman (Rhondda); A. L. Boyle (Scunthorpe); W. D. Brassington (Motherwell); H. Breckell (Gainsborough); P. V. Brittlebank (Johnson & Phillips); S. E. Britton (Chester); G. Broadhurst (Clacton-on-Sea); Sir John Brooke (Electricity Commission); R. A. Broster (Liverpool Elec. Cable Co.); R. L. Brown (Hopkinsons); E. Brunt (Todmorden); J. K. Brydges (Eastbourne); W. A. A. Burgess (A. Reyrolle & Co.); H. R. Burnett (Barrow-in-Furness); J. W. Burr (Swansea); F. C. Burstall (Automatic Electric Co.); H. C. Busbridge (Swinton); F. S. Button; E. Calvert (Finchley); H. F. Castle (Bridport); J. V. Chaplin (Colwyn Bay); Capt. J. C. Chaytor (Tamworth); John Christie; A. C. V. Clarkson (G.E.C.); A. W. Clegg (Accrington); P. Clegg (Morecambe); T. M. Climie (Falkirk); W. N. C. Clinch (Brighton); C. A. Coleman (Turton); N. A. Collard (Brush Elec. Eng. Co.); J. F. H. Colyer (W. T. Henley's Teleg. Works Co.); O. G. Cook (Bingley); W. H. Cooke (Luton); N. B. Coop (British Elec. Meters); A. G. Cooper (Thornton Cleveleys); W. J. Cooper (Hamilton); F. H. Corson (Gloucester); H. Couzens; Alex. C. Cramb (E.D.A.); F. G. Curel (Witney); C. J. Curry (B.T.H. Co.); V. W. Dale (E.D.A.); J. C. Dalton (Prov. Elec. Supply Assn.); T. E. Daniel (Ashton-under-Lyne); B. Darby (Atherton); A. E. Darlington (B.T.H. Co.); C. S. Davidson (Barnes); D. H. Davies (Chesterfield); C. Day (I.Mech.E.); H. C. Day (Heywood); A. J. C. DeRenzi (Newcastle-under-Lyme); H. H. Denton (Crewe); L. J. de Wynter (Brit. Insulated Cables); W. Diamond (Hitchin); C. H. Dobell (Radiovisor Parent); Capt. J. M. Donaldson (North Met); J. G. Doran (Bermondsey); J. P. Dornan (Corfield, Ltd.); R. S. Downe (Brompton & Kensington E.S. Co.); W. H. Duffett (Rotherham); Sir Andrew Duncan (C.E.B.); E. A. Eaton (Brit. Insulated Cables, Ltd.); J. Edgar (South Shields); T. Edgar (Horstmann Gear Co.); J. E. Edgecombe (Kingston-on-Thames); P. M. Edinborough (Auto. Elec. Co.); E. A. Edwards (Simplex Elec. Co.); F. H. Edwards (Dartford); F. F. Elliott (Woolwich); W. R. Elliott (East Ham); J. E. Ellis (Morley); G. J. Evans (Pontypridd); N. V. Everton (Met.-Vick Co.); C. R. Failes (Electrolux); J. C. Fairchild (Lytham St. Annes); Capt. G. F. Falk (Falk Stadelmann & Co.); J. H. Farthing (G.E.C.); J. B. Feltham (Long Eaton); A. E. Felton (Revo Electric Co.); S. Ferguson (Ferguson Pailin); V. Z. de Ferranti; W. K. Fleming (Rothesay); F. M. Fletcher (Darwen); F. Forrest (Birmingham); J. S. Forster (Crook); F. W. Foster (G. Ellison, Ltd.); S. H. Fowles (Heston and Isleworth); O. F. Francis (Kirkcaldy); H. G. Fraser (Oxford); J. A. Fraser (Carron Co.); Capt. C. P. Freeman (M.V. "Georgic"); C. A. Frost (Bexhill-on-Sea); A. J. Fuller (Fulham); C. Furness (Blackpool); W. M. Furniss (Elec. Construction Co.); F. Garside (Aldershot); S. A. Gaskell (Bruce Peebles & Co.); T. Gerrard (Mirfield); S. Cameron Gibson (Nuneaton); A. T. Gillanders (Standard Tel. & Cables); W. A. Gillott (English Electric Co.); P. Good (Brit. Standards Inst.); G. E. Green (G. Green & Co.); C. E. D. Greenhalgh (Ilkley); G. F. Gregory (Ilford); E. Grime (Grays); R. W. Grubb (Dewsbury); R. H. Gummer (International Combustion, Ltd.); J. W. Hadfield (Barnstaple); R. B. Hague (Hague & McKenzie); Harry Haigh (Shipley); H. Hall (Gillingham); T. Hall (Burton-on-Trent); W. H. Hancock (Conway); B. Handley (Portsmouth); A. F. Harmer (Hammersmith); R. C. Harpur (Dover); Miss C. Haslett (E.A.W.); L. P. Haussauer (Aidas Electric); A. M. Hawkins (L. G. Hawkins & Co.); B. T. Hawkins (Wallasey); R. M. Hawkins (Belling & Co.); R. J. Hebbert (Ferranti, Ltd.); C. N. Hefford (Leeds); J. Henderson (Amble); H. J. Herrera (Risca); E. Holcombe Hewlett (Mansfield); R. W. Hewling (Skelton and Brotton); T. W. Hibbert (Doncaster); W. T. Hilder (Haslingden); E. W. Hill (Aron Electricity Meter); W. Hill (Burnley Components, Ltd.); W. C. B. Hillman (Caerphilly); A. H. Hird (Vickers-Armstrong); Allen Hirst (Brookhirst Switchgear); E. E. Hoadley (Maidstone); Major L. B. Hogarth (Whitehaven); C. Hollander (English Electric Co.); G. J. Hollyer (Torquay); E. C. Holroyde (Crompton Parkinson); J. Hopton (Normanton); F. C. Horsford (Henley's); A. J. Howard (Taunton); J. S. Huddleston (Union Cable Co.); J. B. Hudson (Leigh); P. V. Hunter (Pres. I.E.E.); S. C. Hurry (Jackson Electric Stove Co.); A. J. Hutchinson (Farnworth); R. Illingworth (Poplar); J. F. Irvine (E.W.F.); C. W. Jackson (King's Lynn); W. A. Jackson (West Bromwich); W. F. Jackson (G. Bray & Co.); H. James-Walmsley (Baldwin & Co.); E. J. Jarvis (Scarborough); E. J. Jennings (Birmingham); A. C. Johnson (Southend-on-Sea); C. M. Johnston (Shrewsbury); W. S. Johnston (St. Helens); B. Jones (Bedwelty); E. W. Jones (Mountain Ash); J. T. Jones (Gellygaer); W. E. Jones (Basingstoke); W. J. Jones (E.L.M.A.); A. L. Keet (Exeter); J. Kemp (B.T.H. Co.); T. A. Kerr (Stretford); W. E. Kidner (Barking); T. A. Kingham (Kingston-on-Thames); D. M. Kinghorn (Southwark); J. D. Knight (Ealing); W. C. Knowles (Elland); W. W. Lackie (Electricity Commission); G. H. Lake (Nottingham); H. C. Lamb (Manchester); J. Lambert (Perth); A. L. Large (Bulpitt & Sons); H. Large (Stoke Newington); E. T. Lawson (A. Reyrolle & Co.); J. Leadbeater (Hampstead); R. Lee (St. Pancras); B. E. Leeson (Switchgear & Cowans); Frank E. Lewis (Canterbury); W. P. Lilwall (Fleetwood); R. H. Line (Electric Domestic App. Co.); H. A. Lingard (B.T.H.); R. E. Livesley (Newark-on-Trent); B. S. Lord (Cleethorpes); Duncan W. Low (Arch. Low & Sons); J. H. Lumsden (Stalybridge & Dist. Elec. Bd.); J. R. P. Lunn (Darlington); W. M. Lydall (Yorks. Elec. Transformer Co.); A. P. MacAlister (Islington); T. A. MacLaughlin (I.F.S. Electy. Board); L. Mackinnon (M.T.T.A.); A. J. Macphail (Brit. Insulated Cables); R. V. Macrory (Londonderry); W. D. Madden (Hick, Hargreaves & Co.); T. A. G. Margary (Wolverhampton); Prof. E. W. Marchant; K. D. Marsden (J. A. Crabtree & Co.); S. G. Marsden (Stockton-on-Tees); W. J. Marston (Coventry); T. D. Martin (Nelson); T. R. Martin; M. S. Mason (Worksop); F. V. L. Mathias (Warrington); P. M. Maxwell (Batley); W. R. May (Lowestoft); D. McDougall (Greenock); C. F. McInnes (Gravesend); A. E. McKenzie (Wimbledon); G. C. McLean (Inverness); N. McLean (Harrogate); W. H. Metcalfe (Bacup); E. H. Miller (British Sangamo); A. E. Mills (M.K. Electric); E. A. Mills (Hackney); G. C Milnes (Lancaster); C. O. Milton (Maidenhead); D. R. Moffat (Moffats, Ltd.); W. F. Moir (E.L.M.A.); A. Nichols Moore (Newport, Mon.); E. Morgan (Sheffield); R. J. Morris (Edison Swan Cables); M. J. Mortimer (Loughborough); J. Mould (Leicester); E. Moxon (Southport); E. K. Muir (J. H. Tucker & Co.); A. M. Mulliner (Middleton); H. A. Nevill (Peterborough); C. G. Morley New (Cardiff); E. S. New (D.P. Battery Co.); F. Newey (Lincoln); P. E. Newnham (C. A. Parsons & Co.); A. J. Newman (Bristol); C. E. Newton (Brit. Insulated Cables); F. Nicholls (Derby); E. J. Nichols (York); A. Nicklin (Swindon); Geo. Nicolson (Weymouth); G. H. Nisbett (Brit. Insulated Cables); F. L. Ogden (Oldham); D. H. Ogley (Wardle Engineering Co.); G. H. Oldroyd (Stockport); J. Orringe (E.C.A.); R. Owen (Wigan); Sir Archibald Page (C.E.B.); H. H. Parker (Pudsey); W. A. Parker (Workington); D. Parkinson (New Switchgear Construction Co.); V. Alex. Pask (Norwich); F. J. Pearce (G. H. Scholes & Co.); Dr. S. L. Pearce (London Power Co.); F. L. Pedley (Hazel Grove); L. C. Penwill (E.C.A.); J. W. Perkins (Foster Engineering Co.); R. W. L. Phillips (Bedford); A. Pickersgill (Spenborough); J. S. Pickles (Dumfries C.C.); H. C. Pierson (Met.-Vick. Co.); J. W. Piggott (Whitby); Chas. Pipkin (Callender's Cable & Cons. Co.); A. D. Pluck (Congleton); G. Porter (Worthing); J. G. Potts (Bury); Edwin T. Pound (North Berwick); R. Povey (Greengate & Irwell Rubber Co.); G. G. L. Preece (Bruce Peebles & Co.); H. A. Pryor (Siemens Elec. Lamps & Supplies); F. W. Purse (London & Home Counties J.E.A.); A. B. Race (B.T.H. Co.); M. J. Railing (B.E.A.M.A.); H. Raine (Annfield Plain); P. N. Rand (Electl. & Eng. Products); J. Ratcliffe (Whitworth); W. E. Rawlinson (Hotpoint Elec. App. Co.); Sir William Ray (E.D.A.); E. J. Rees (Neath); F. H. Reeves (Revo Electric Co.); F. N. Rendell-Baker (Croydon); C. G. Richards (Port Talbot); A. J. Richardson (Hawarden); E. K. Richardson (Tilbury); J. H. Rider; F. Ridout (G.E.C.); G. E. Riley (B.T.H. Co.); A. S. Rinder (Met.-Vick.); J. G. Robertson (Babcock & Wilcox); J. N. Robertson (Brit. Elec. Transformer Co.); W. H. Robins (Stafford); I. V. Robinson (B.E.A.M.A.); L. L. Robinson; P. J. Robinson (Liverpool); Sir Alexander Roger; T. Roles (Bradford); L. Romero (Salford); A. E. Roots (Dumfries); J. H. Rothwell (Hon. Solicitor); H. G. Rowe (B.T.H. Co.); Wm. A. Royle (Blackburn); F. H. Rudd (Rochdale); W. F. Russell (Lichfield); A. J. Ryan (Hastings); P. E. Rycroft (Great Yarmouth); C. W. Salt (Carlisle); R. H. Schofield (Ferranti Ltd.); R. H. Scotson (Middlesbrough); E. Seddon (Edinburgh); W. M. Selvey; R. O. Seville (Wakefield); L. C. Sharp (Venner Time Switches); C. M. Shaw (Worcester); A. Shelton (Berry's Electric); T. S. Shenton (Rugby); J. E. Shepherd (Rawtenstall); J. H. Shepherd (Harwich); G. F. Sills (English Electric Co.); J. S. Simmons (Henley's); J. F. Simpson (Preston); J. W. Simpson (Secretary); C. H. Smith (Electric Fires, Ltd.); R. W. Smith (Drake & Gorham Wholesale); W. J. Smither (Dorchester); C. H. Smyth (St. Marylebone); W. V. Smythe (Skipton); G. Sommerville (Faversham); G. E. Soulsby (Tanfield); J. W. Spark (Bath); F. E. Spencer (Birkenhead); G. R. Spurr (Walthamstow); C. H. Stagg (Eaton); J. E. Starkie (Burnley); J. G. Statter (J. G. Statter & Co.); D. J. Strutt (B.T.H.); C. W. Sully (E.L.M.A); H. H. Sutcliffe (Hebden Bridge); M. G. S. Swallow (Richardsons Westgarth); H. W. Swann; F. Swarbrick (Hove); P. H. Symonds (English Electric Co.); R. C. Symondson (Unity Heating); C. D. Taite (I.A.E.P.C.); J. E. Tapper (Beckenham); W. C. P. Tapper (Stepney); A. Taylor (Heckmondwike); C. R. F. Taylor (Smith Meters); R. C. Taylor (Santon, Ltd.); W. S. Taylor (Mersey Cable Works, Ltd.); W. J. Terry (Liverpool Elec. Cable Co.); T. Dawson (Abertillery); J. R. Thomas (Edison Swan Elec. Co.); T. S. Thomas (Bedwas and Machen); J. H. Thompson (Coine); G. W. Thomson (W. T. Glover Co.); S. Tillotson (West Hartlepool); A. H. Todd (Clitheroe); R. N. Torpy (Tunbridge Wells); J. W. J. Townley (West Ham); T. G. Travis (G.E.C.); W. G. Trend (Bromley); H. A. Tulloch (Leek); C. Turnbull (Tynemouth); W. A. Turnbull (Aylesbury); Capt. C. J. Turner (Hoylake); J. W. Turner (Huddersfield); W. G. Turner (Southampton); W. H. Turner (Yorks. Switchgear & Engineering Co.); G. C. Usher (Combustion Steam Generator, Ltd.); Col. W. A. Vignoles (Evershed & Vignoles); G. A. Vowles (Halifax); J. N. Waite (Hull); D. D. Walker (Evershed & Vignoles); Ald. W. Walker (C.E.B.); E. A. Ward (Siemens Elec. Lamps & Supplies Co.); W. P. Ward (Brit. Insulated Cables); P. Wardle (Cannock); A. J. Waring (Felixstowe); V. Watlington (B.E.A.M.A.); Col. H. W. Watts (Epsom); O. C. Waygood (I.E.E.); H. Webber (Keighley); B. Welbourn (Brit. Insulated Cables); J. Wetherell (Leyton); P. F. White (Bangor); E. Whiteley (Measurement, Ltd.); F. H. Whysall (Belfast); T. Wilkins (Penybont); G. Wilkinson; H. Wilkinson (Radcliffe); D. J. Williams (Mynyddislwyn); F. H. Williams (Jackson Elec. Stove Co.); J. C. Williams (Erith); J. W. Williams (Wrexham); R. Willis (Cheadle); H. Wilson (Ashford); F. H. Windibank (Crompton-Kye Lamp Sales, Ltd.); S. R. Windle (Grimsby); C. J. Wood (Sale); E. D. Wootten (Malvern); Alan Wright (Geo. Bray & Co.); C. H. Yeaman (Stoke-on-Trent).

DD



A 350-kW pass-out engine d.c. generator set at the Crimble Mill, Heywood (See page 785)

At the Liverpool Exhibition

From Our Special Representative

LIGHTING equipment is very much to the fore at the I.M.E.A. exhibition this year, largely, but not wholly, on account of the development of the gaseous discharge lamp. A fitting which appealed to me is that produced by

Street lamps controlled by Strowger relay (see page 803). Top right: An Ediswan floodlighting projector for gaseous-discharge lamps. Bottom right: Refractor diffuser for gaseous-discharge lamps in " Wembley " fittings

Siemens Electric Lamps & Supplies, Ltd. It is square shaped with the lamp centrally and vertically suspended from a vertically adjustable holder. Below the lamp are bracketed vertically four small opal-type plate reflectors which can each be swung independently through a wide angle. In this way the horizontal diffusion is subjected to fairly fine control. Further, diffusion control in the vertical plane is provided by two adjustable mirrored curved reflectors at the top.

A floodlighting projector which I saw on the stand of the Edison Swan Electric Co., Ltd., is made of lead-coated steel lined with rippled silvered glass. The " Goliath " holder is easily accessible and has two positions. It is well ventilated.

The General Electric Co., Ltd., has a good scheme in a refractor-diffuser by which gas-discharge lamps can be used in " Wembley " and other lanterns. It is cylindrical and in one piece, and it is designed to give an asymmetric non-axial distribution having two main beams at 160 deg. to each other. Internal prisms and external vertical flutes result in the brightness of the lantern being reduced by spreading the source image over the whole sides. I was also told of a new " Osira " lamp of 250-W loading for secondary streets.

I learnt that in the autumn the E.L.M.A. members will introduce a 40-W gas-filled lamp which will provide 20 per cent. more light. A 60-W lamp will follow. Better advantage is taken of gas filling by further reducing the surface area of the filament presented to the gas, by coiling the actual coiled filament.

The " Strowger " street-lighting control system introduced by the Automatic Electric Co., Ltd., is a " star turn." As I saw it street-lighting fittings are controlled *via* a telephone-type relay in each standard, switching, in sequence, *via* a three-point contact, two lamps on, one lamp on, both lamps off. The relays are operated by impulse currents superimposed on the actual supply circuit and transmitted from a controller in the sub-station, &c. The impulses are governed by a time switch in the transmitter.

Venner Time Switches, Ltd., have a synchronous-motor time switch in which there is a device in the spring to prevent overwinding, while the spring is kept sufficiently wound to afford from forty-eight to sixty hours' reserve when the supply is " off." They also showed me a two-rate quarterly meter with the time switch in the same case, and a two-part tariff prepayment meter with a change-rate device which will vary the rate, without altering the gearing, from 3d. to 8s. per week.

The " D " drop-out lift-off overhead-line switch-fuse shown by Johnson & Phillips, Ltd., has an expulsion fuse unit with a lift-out hinge at the bottom and a latch at the top. The catch is held " in " by tension of the fuse wire and is released when the latter blows, so that the fuse unit drops out and hangs down. I saw displayed by Measurement, Ltd., a small automatic house-service breaker. One of its two coils trips instantly on heavy overloads and the other has a double winding. One winding energises the coil for lift, and the other (operating) winding is controlled by bi-metal strips.

Small Cookers

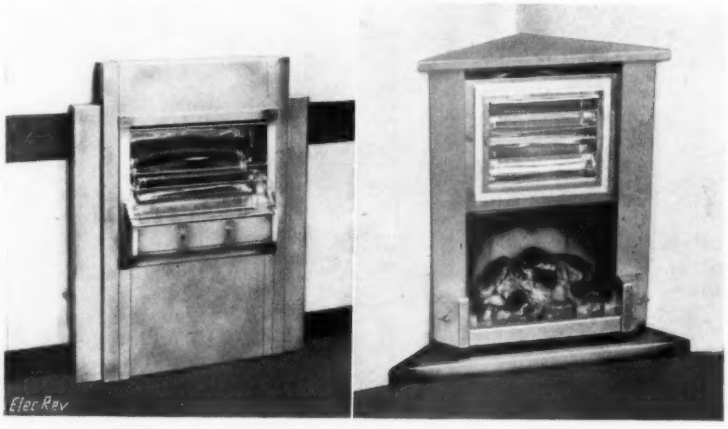
The Hotpoint Electric Appliance Co., Ltd., showed me a cooker with a 1,600-W " Torribar " boiling plate and a 1,900-W griller-boiler within a hob measuring 20⅜ in. by 16¼ in. It has a door to the grilling chamber, and the two-bar braced plug-in elements at the bottoms of the oven sides provide a shelf runner between the bars. The underside of the griller-boiler top is vitreous enamelled.

On the stand of the General Electric Co., Ltd., I saw the latest and smallest of the " standardised " range. It has a 1,800-W boiling plate, no grill and no warming cupboard, but top oven heating provides for grilling. It has a total load of 4 kW. The foot clutch for the oven door that I saw on the 91J produced by the Jackson Electric Stove Co., Ltd., is a good idea. A new development in automatic oven control is the " Autotherm " introduced by the Revo Electric Co., Ltd. It provides four automatic settings and serves as the actual oven switch. The thermostat is similar to the tube and rod type used for water heaters, and the very small break indeed eliminates arcing. Another similar development, by the English Electric Co., Ltd., employs an Igranic automatic controller with a rod-type thermostat and a mercury switch.

I had been anxious to know why in their new " Servis " cookers Falk, Stadelmann & Co., Ltd., had adopted quarter load for medium heat and one-sixth load for low heat. Mr. Bickell explained that there is greater flexibility of control at the lower temperatures where it is wanted. One-sixth load is just about sufficient to off-set the losses for the lower set temperatures. I was surprised to learn of the small difference in price between the " sealed oven " cookers and the new additional ones with ordinary plug-in elements. Model C8 (6,050 W) costs £13 10s. 6d., and the equivalent model with ordinarily disposed elements costs £12 17s. 6d.

Boiling Plate Developments

Test figures given me for the new " Magnet " 2,250-W boiling plate and the existing 1,800-W plate are: 2 pints boiled in 6.2 min. for the new unit, and 2 pints in 7.5 min. for the older one. The boiler-griller in the new English Electric cooker and breakfast cookers is made up of inverted light stainless-steel channels, accommodating the spirals within them on the under side. The light metal affords a quicker boiling from cold, but necessitates the channel construction for strength. The new low-voltage plate of the Simplex Electric Co., Ltd., is now displayed on several of their cookers.



Left: A Ferranti " builder's " fire. Right: A Berry corner fire

I saw several new water heaters, but they appear to be new only in size. There are still more under-the-basin units—" Magnet " and " Highlow " being two of the makes I saw.

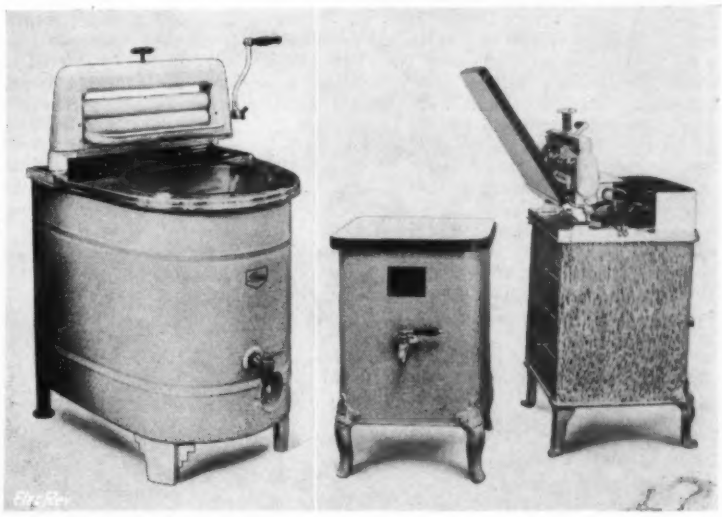
In the heater introduced by Archibald Low & Sons, Ltd., for use with hard water all the parts are easily removable for cleaning.

Immersion-heater business is forging ahead, but I saw few changes in design. The "Heatrae Ace" introduced by Electric Fires, Ltd., has the element and the thermostat contained within a 2-in. threaded gland, the thermostat being entirely separate from the element housing and fixed on the flat "cut-away" side of the tube. The external thermostat definitely eliminates "hunting," I was told. A scheme initiated by George Green & Co. provides the thermostat within the sheath of a blade-type element. I saw this in both a self-contained water heater and a separate immerser.

Lower-priced Washing Machines

The Revo combined wash-boiler and washing machine holds 12 gal. and is loaded at 4 kW. A motor fan within the outer casing at the top draws air from the container above the water, through gauze, and blows it up through holes near the centre of the bottom and others under turbulence vanes fixed on the container interior. Elimination of the gyrator, with consequent safety, has rendered this scheme possible. This will probably be sold at about 16 guineas. A "Magnet" washing machine at 19 guineas was another surprise. The gyrator is stopped and started by a clutch operated simply from the top of the centre piece in the container.

Table-top washers are displayed by Burnley Components, Ltd. Two square equipments, one a combined washer and wringer and one a washer only, have enamelled tops, and in the combination the hinged "table" is lowered to fit over the hinged and lowered wringer. An enamelled front piece between the table top and the washer completes the nesting of the wringer.



Left: The "Revo" combined washing machine and wash-boiler. Right: The "Burco" washer and combined wringer and washer

Improved Inset Fire Business

I saw more inset fires than ever, both new models and new makes. Mr. Hawkins, of Belling & Co., said that they represented enormous business. Carron Company considers that the reflector fire is the right idea for this type of equipment. Chromium plating, in eliminating discoloration prevalent with nickel plating, has resulted in the maintenance of maximum radiation efficiency. I saw on this stand a 2,000-W two-rod model with separate trough reflectors, which can be supplied with the elements either vertical or horizontal.

"Builders' fires" I heard them called on Ferranti's stand, where I saw new models with metal or tile surrounds, and a shorter reflector, but employing the standard Ferranti parabola. A three-in-one "Xcel" fire is a good scheme, I think. With its legs it is a screen fire. With the legs removed it can be bolted from the front for permanent fixing as an "inset," or bracketed by an adjustable rod at the back for semi-permanent fixing. There is an imitation-fuel corner fire with reflectored elements displayed by Berry's Electric, Ltd., and I saw a new Belling corner fire.

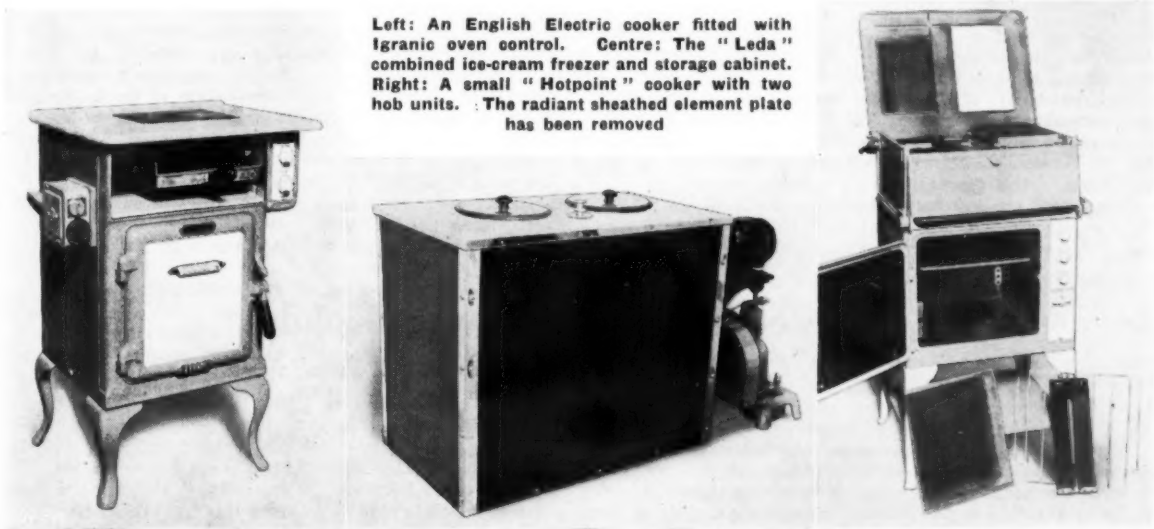
While there are a few tubular heaters on most heating equipment manufacturers' stands, I should not call the low-temperature heating display generally a strong one. True, Greene Phillips & Co., Ltd., have a good show of convectors, and Unity Electric Heating, Ltd., have staged an excellent selection of their panel-type heaters, &c. I like the new "P.H. Handy" heater, but its use should not be confined to airing cupboards. A further addition to the growing number of convectors is an English Electric model. It has a finned tubular heater at the bottom, is loaded at 800 W, and is designed for an outlet temperature of 200 deg. F.

M. K. Electric, Ltd., showed me a small and simple control unit which has resulted from many inquiries for such apparatus for use with tubular heaters. Its metal case measures about 3 in. by 6 in. by 4 in. deep, and it has a 15-A d.p. switch and a pilot light. A control unit of "Heatrae" manufacture for immersion heaters is somewhat similar, having a three-heat rotary switch, a pilot lamp and terminals within a case measuring about 4 in. by 8 in. by 3¼ in. deep.

Displayed by the Liverpool Electricity Department I saw an "Xcel" cooker with its control gear-main switch, plug and pilot light—in effect, the control unit—embodied in the cooker structure.

Bulpitt & Sons, Ltd., aim at shortening boiling times by increasing the emission area of the immersion heater employed in their kettles. In one case this is done by special shaping, and with a load of 2,000 W three pints of water are boiled in five minutes.

There is very little refrigeration equipment on show. The new "Sparton" shown by Drake & Gorham Wholesale, Ltd., has the compressor unit at the top to reduce vibration. The ice cream freezer and storage cabinet shown by Leda Electric, Ltd., has two separate motors—one for the compressor and one for the mixer. Further illustrations appear on page 803.



Left: An English Electric cooker fitted with Igranic oven control. Centre: The "Leda" combined ice-cream freezer and storage cabinet. Right: A small "Hotpoint" cooker with two hob units. The radiant sheathed element plate has been removed

Mr. Robinson's Presidential Address

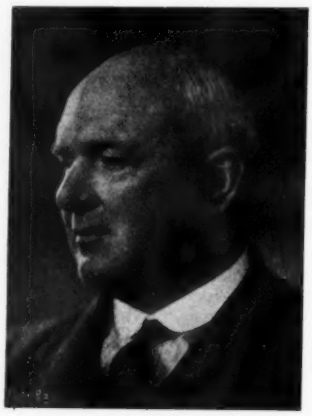
PREFACING his address with an expression of disagreement with the suggestion that municipal control of electricity undertakings has been found wanting and is therefore doomed, the president maintains that the majority of the municipally owned undertakings have nothing to fear by comparison with companies, both in respect of development of service and the price actually charged to the consumer.

Success depends very largely upon the "man on the job," and no amount of rationalisation can produce such good results as an energetic engineer who has a reasonably free hand. The latter condition is in some cases lacking and the limitation of competition which is imposed on some engineers is an extremely pernicious policy.

The importance of avoiding joint control of electricity and gas undertakings is urged strongly. Such collaboration is narrow-minded and detrimental to the prosperity of the country as a whole, since the benefits of electricity to the community can far outweigh any gas development which might be obtained by artificial restriction of the use of electricity.

Whether amalgamation of adjacent small undertakings is entirely desirable depends upon local conditions. A small concern controlled by an enthusiastic engineer will be able to give a cheaper supply and render more efficient service than those available from a much larger undertaking under a lethargic or "hand-tied" engineer, or from a bureaucratic organisation operating without local knowledge and goodwill.

The rating of electricity undertakings is also going to militate against development. The president suggests that there should be a uniform system of assessment, preferably carried out by a central authority. The Government should consider whether the industry could be given the benefit of derating to the same extent as manufacturing industries.



Mr. P. J. Robinson, M.I.E.E., city electrical engineer, Liverpool

Every effort must be made to foster the subconscious association of electricity with the amenities of life and the realisation that it is not the rich man's luxury but the servant of everyone. This can most successfully be done by national rather than local advertisement and propaganda. But national movements depend upon local support for their success, and such organisations as the E.D.A., E.R.A., and E.A.W. must be encouraged financially and otherwise by individual undertakings.

One of the first ways of giving such national effort local support is by developing the spirit of service to the consumer as a guiding principle impressed deeply on the minds of every member of the staff. Not only is it essential that new installations should be coupled up and existing installations extended as soon as possible after application by the consumer, but, in addition, a promise given to a consumer, actual or potential, must never be broken.

The installation of a complete electric cooking equipment in a restaurant on the principle of "no satisfaction, no pay" is probably contrary to the usual ideas of finance of the average corporation auditor, but any sound private firm would look upon such a procedure as an ordinary commercial risk, and so should an electricity undertaking.

To critics ready to talk about waste of ratepayers' money the president suggests that providing an electricity undertaking gives a low-priced reliable supply with an efficient service to consumers, and maintains a reasonable reserve fund, then the engineer should be given a free hand in the financial administration as distinct from financial control, *i.e.*, audit.

To obtain maximum development the following points are worthy of consideration:—

(*a*) Schemes for hiring and maintenance of apparatus; (*b*) assisted wiring schemes, particularly in co-operation with local registered contractors; (*c*) systematic canvassing; (*d*) exhibitions in model houses on new building estates; (*e*) lectures on electric cooking in schools; (*f*) special terms for equipment and supplies of current to cookery schools; (*g*) encouragement of "off-peak" loads; (*h*) showroom demonstrations; (*j*) wireless and wireless rediffusion on the mains; and (*k*) training of staff.

In addition, the president urges the necessity for adopting simple tariffs, and avoiding elaborate legal documents in connection with supplies, hiring of apparatus, &c. There is no doubt that any gain, due to protection from loss obtained by the adoption of "water-tight" agreements, is more than lost through the restrictions which these forms put on free development. Standardisation and simplicity of design of apparatus, particularly for domestic purposes, are of the utmost importance. The fact that high initial cost is one of the greatest hindrances to progress has been shown by the amazing success of assisted-wiring schemes. If the benefits of electricity are to be available to the full to the working-class householder, then the minimising of initial cost will be of even greater importance in the future than in the past.

Even if apparatus is hired out by the supply authority, the first cost must be brought down if hire rates are not to assume excessive proportions. It is difficult to understand why the prices of so many types of domestic equipment should be so high. Undoubtedly lack of standardisation is largely responsible, but, at the same time, there is a great scope for manufacturers to reduce their costs.

The distinct tendency to replace electric trams by petrol buses has made an appreciable reduction in the usage of electricity, although, at the same time, relieving electricity supply undertakings of a load which not only is definitely "on-peak" but is also one which makes severe demands on the plant. The main reason for this is that those responsible for tramways have absolutely neglected to move with the times in considering the comfort of passengers, and have continued to build tramcars in which the standard of comfort, or lack of it, is that adopted thirty years ago.

Progress demands five essential requirements: 1. Simplification and standardisation of domestic electrical apparatus in order to decrease the cost. 2. The minimum possible initial cost to the consumer. 3. A stimulation of the co-operative spirit; everyone must work for the common good. 4. A removal of all artificial restrictions on the use of electricity. 5. Enthusiasm for the extension of its use on the part of everyone engaged in the industry.

Never was there a more worthy object of enthusiasm than the extension of the use of electricity, but do we always realise it? Are we too familiar with it to appreciate its benefits fully?

Developing the Power Load

Paper read by H. C. Lamb and W. E. Swale on Tuesday, May 29th

THIS paper surveys the existing industrial power load and discusses means of accelerating its development. The last Census of Production reveals that in 1930 five industrial groups accounted for 75 per cent. of the total h.p. in use. The proportion of power furnished by electric motors is rising rapidly; in 1930 it was some 60 per cent. of the total power in use.

Of the prime-movers "ordinarily in use" about 67 per cent. is represented by steam engines (steadily decreasing) and 23 per cent. by turbines (rising). Of a total of 11,158 million kWh used in industry in 1930, including supplies for lighting and industrial heating processes, about 50 per cent. was purchased from electricity supply authorities. The total capacity of motors supplied from private generating plant increased from 1924 to 1930 by 28 per cent., while the capacity of motors driven by purchased electricity increased by 43 per cent. in the same period.

A questionnaire asking I.M.E.A. members for information about private plant installed in their areas revealed a surprisingly large number of authorities which had no information available, or sent in palpably incomplete returns. Considering that a knowledge of competitors' activities is a fundamental requisite of sales planning this fact is regrettable.

However, returns from 136 undertakings recorded 686 engines aggregating 155,010 h.p., of which 23 per cent. was applied direct to line-shafting and 77 per cent. to the generation of electricity. The Census showed the proportion of mechanical drive to electrical generation to be roughly 40 and 60 per cent. There is thus a distinct movement in the direction of still further electrification of power plant, which is all to the good since electrified works are usually more favourable propositions for ultimate connection to public supplies.

From these and other sources of information the authors conclude that by far the largest amount of private plant in-

stalled in the five years ended 1933 is represented by pass-out turbines. Steam engines are of small size and largely of the pass-out type, while the increase of gas engines is negligible. A considerable amount of oil-engine plant is characterised by special conditions, such as non-availability of public supplies, considerations of policy, &c., which obscure the purely economic comparison with the costs of public supplies. The authors have accounted for some 364,400 h.p. of private plant installed in the five years ended in 1933, but they have reason to believe the total to be of the order of 700,000 h.p.

Power Sales Methods

The second part of the paper discusses competing power services. So often the case for public supply is inadequately presented and the fallacies which frequently underlie the competitive offer are not exposed as they might be. The authors appeal for a change in outlook towards the whole aspect of power sales. They advocate a rather more elementary, and at the same time fuller, exposition of the advantages of purchased electricity from the point of view of the potential user.

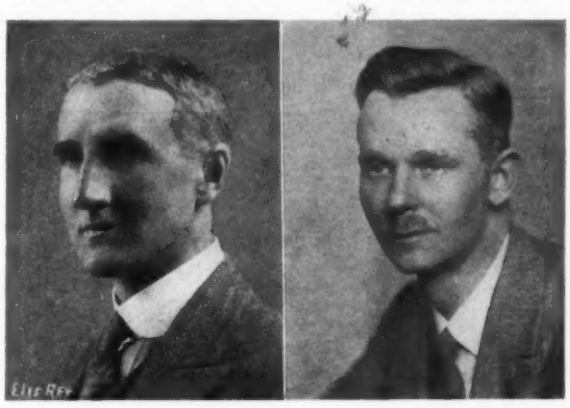
The business of the sales staff is essentially to maintain close personal contact with the principals of all works operating private plant and to engender such a spirit of confidence as will induce the user to seek advice. An unbiased view of the circumstantial claims of competitors is essential. The power salesman should assimilate the experiences of existing users and employ the knowledge thus gained to present the case for electric power in the most convincing manner.

The authors maintain that power sales should be prosecuted with as much energy and commercial acumen as are now devoted to the lighting and domestic sales. Their constructive proposals include a progressive policy with an adequate power sales staff which should function as a separate section. In far too many undertakings power sales work is not treated as a specialised activity.

The existing private plant capacity is estimated at 9.5 million h.p. and the apparent lack of any accurate knowledge about this load leads the authors to suggest that each electricity supply authority should carry out a survey in its own area. The value of the Manchester census and the very useful information which is revealed by annual revision of the list are referred to at some length.

In putting forward suggestions for local publicity the British Electrical Development Association is instanced as an excellent organ for co-operative sales activities which might be made still more effective for the immediate end in view. For example, the mass of data available to electricity supply authorities regarding the applications of electricity to numberless industries might be utilised far more effectively than is being done at present if it were collated by E.D.A., systematically studied, and then passed out again in suitable form for the benefit of the industry at large. Excellent work has already been done by means of special studies of such subjects as industrial heat treatment, commercial baking, building warming, &c.

The authors tabulate those industrial groups in which the proportion of purchased electricity is still disappointingly low. For example, the question why, in 1930, the group "Public Utility Services" (where presumably little process steam is required) should have had only 23.5 per cent. of its power plant connected to public supplies might well form the subject of an early E.D.A. investigation. Other subjects for national or regional investigations—for example, the coal mining industry—will readily come to mind. It is not suggested that E.D.A. Sub-Committees should usurp the functions of the large electrical manufacturing firms who are constantly pushing ahead electrical development in the more "difficult" industries, but rather that attempts should be made to analyse, and subsequently advertise among supply authorities the conditions which tend to favour public supply development. An important part of such specialised industrial studies would be



[*Lafayette* [*Elliott & Fry*

Mr. H. C. Lamb is city electrical engineer of Manchester and Mr. W. E. Swale is a member of his staff

to determine in which particular trade journals collective advertising of public supply would be most effective, and to key in such advertising with organised sales campaigns.

The technical assistance which can be given by the Central Electricity Board in cases of exceptionally difficult power negotiations is perhaps not yet fully appreciated by supply engineers. This, again, is a feature of national co-operation in which the experience of one particular negotiation is available to other engineers faced with similar circumstances.

The rapid increase of the domestic load under the influence of concerted national action shows that an equally vigorous growth of power sales is essential if a sound balance of industrial and domestic loads is to be maintained. A wider appreciation by members of Electricity Committees of the interdependence of all classes of electricity supply is urged, with a realistic view of the supply industry's obligations towards the manufacturing community. Unless the sale of electric power to industry is taken up vigorously and efficiently by municipal authorities it is probable that the future will see great and drastic changes in the direction and control of electricity supply undertakings.

Present-day Practice in A.C. Urban Distribution

Paper read by L. Romero on Wednesday, May 30th

THIS paper gives the results of a questionnaire that was addressed to sixty of the largest municipal undertakings throughout the country. From the replies it is inferred that probably about one-half the urban l.v. networks are three-phase four-wire systems. Less than half the undertakings are adopting the national standard system throughout for new l.v. networks. The average of the percentages of consumers who still have non-standard voltages in fifty-two undertakings is 52.5 per cent.; even when the thirteen undertakings which are now standardising have finished, the average will still be 39.5 per cent. Change-over to standard voltage is being prevented by the expense, but the author considers that the freedom which undertakers enjoy of extending their systems at non-standard voltages should at least be taken away.

The change-over from d.c. to a.c. is much more forward, because it pays for itself in a very short time. Eleven undertakings have always been a.c.; nine have completed the change-over and the remainder are doing so; three are changing part of their systems only. The low-voltage networks of eighteen out of forty undertakings have been completely changed-over; the average is 91.3 per cent. completed. Considerable economy is effected by completing the l.v. network on a definitely organised plan, instead of extending mains piecemeal as applications for supply are received.

The majority do not interconnect their l.v. transformer sub-stations at all. Four only operate with the whole of their l.v. networks interlinked through fuses, namely, Bradford, Leicester, Sunderland, and York.

Eight undertakings only have adopted the new standard cables (B.S.S. No. 480, 1933), three for 460 V and five up to 1,000 V. The majority use shaped conductors only, which are cheaper; it would appear desirable that their use should be extended. Thirty-one out of forty-three undertakings use steel-tape armoured cable laid direct in the ground, while ten economise by not using any warning or protective covers over the cables. The author considers that interlocking brick tiles stamped with the voltage are the most economical, satisfactory and durable cover for l.v. cables. The fact that Bradford and Manchester, partially, use unarmoured, lead-covered, jute served or braided l.v. cables direct in the ground suggests further inquiry into the possibility of dispensing with armouring.

Among the forty-three undertakings the neutral core is the same section as the phase cores in all cases but two up to and including 0.06 sq. in.; above 0.06 sq. in. and up to and including 0.25 sq. in. there are only seven undertakings using a reduced neutral conductor. The practice of the great majority of making all four cores equal is a wise one to follow,

especially in view of the relatively large single-phase load demanded by domestic users for cooking and heating, and the high diversity factor of these loads. The Electricity Commissioners' revised Regulations provide that no consumer shall have his l.v. circuits connected to more than one phase or one outer of the supply unless the total rating of his installation exceeds 15 kW. This will have the effect of increasing the magnitude of the currents to be carried by the neutral conductor in nearly all undertakings and will help to make the use of four equal cores in l.v. distributors universal.

[*Lafayette*
Mr. L. Romero is city electrical engineer of Salford

The number of disconnecting points, apart from transformer sub-stations, per square mile of l.v. three-phase network varies from 12 to 111. For protecting outgoing l.v. circuits from sub-stations fuses are very much cheaper than oil switches, both to install and maintain.

House service fuses are mostly of the bridge type, but performance tests recently carried out by the author incline him to believe that the cartridge type will come into general use for this purpose. The contact and length between centres of all makes should be standardised, while the all-insulated fuse box and meter are sure to win early general adoption.

Twenty-three undertakings make it their standard practice to run only one phase and the neutral into dwelling houses, even when a cooker, water heater, and fires are installed. Omitting houses of over £100 rateable value, there would appear to be no need in urban areas to balance the load of individual domestic consumers. Where the practice of balancing consumers (of 3, 8, and 10 kW installed capacity) obtains it would appear to be necessary to lay three- or four-wire services to all houses, except perhaps small cottages, because it is anticipated that a very large proportion of them will eventually install at least an electric cooker and water heater, whatever they may apply for at the start. In the author's opinion it is undesirable to lay three- or four-wire services into ordinary domestic premises, first, on grounds of economy; secondly, because of the extra space required in the house; and, thirdly, on grounds of safety if the consumer's installation is actually balanced. Regulation 28 of the Electricity Commissioners' revised Regulations if enforced would probably put an end to the balancing of individual domestic consumers' installations, except in very large houses, and, in the author's opinion, that would be a desirable consummation. For business premises, however, which have large lighting loads with no diversity the conditions are very different.

On the question of the standard size or sizes of two-wire service cable used there is something approaching unanimity in the use of 0.0225 sq. in. The many types of service joint in use suggests that the "best" is decided chiefly on the basis of cost. The most frequently used seems to be lead sleeves in cast-iron boxes.

The author's opinion is that the practice of nearly 75 per cent. of the cases of equipping sub-stations with one transformer only is sound, provided facilities exist for rapid replacement in the rare event of breakdown. There appears to be disinclination in some quarters to use consumers' sub-stations to feed the network, though the practice has been widely and successfully adopted. Of the 3,352 network sub-stations returned by forty-four undertakings, 955, or 28.5 per cent., are on consumers' premises. The average area fed per l.v. sub-station is 0.21 square mile.

Transformer Sizes and Tappings

The standard method of protecting single-transformer sub-stations is by over-load and earth leakage on the h.v. oil switch, but there is much diversity when more than one transformer is installed. The size of transformer also differs greatly, but concentration on the 500-kVA rating is suggested. The general practice is to install ±2.5 and 5 per cent. tappings, but it is considered that the majority of undertakings do not need so wide a variation as 10 per cent. Impedance is between 4 and 5 per cent.

The most common primary voltage is 6,600 V, though 11, 22, and 35 kV are also in use. The author is convinced that when conditions permit the treatment of the e.h.v. feeder and step-down transformer as a single unit for switching and protection is a very definite means of economy and simplification. The multiplicity of sizes of h.v. cable is undesirable, and the author suggests 0.25 sq. in. for feeders and ring mains.

Only fourteen of forty-seven undertakings are installing network sub-station h.v. oil switches of a breaking capacity less than 100,000 kVA, and there appears to be much in favour of standardising 250,000 kVA as the minimum size. Thirty-two out of fifty undertakings are now installing metal-clad h.v. switchgear in their network sub-stations.

The great importance of good voltage regulation is emphasised. On-load tap-changing gear, mostly automatically operated, on power transformers is the most generally adopted means. The legal limits are now ± 6 per cent., but thirty-four undertakings still work at ± 4 per cent., while nine aim at closer limits; the author suggests a range of plus 6 per cent. and minus 4 per cent. in rural areas.

Finally the author suggests that the I.M.E.A. should tackle consumers' voltage and other standardisation problems without delay. If it shows itself capable of appreciating the national point of view and acting on matters of this kind, those who advocate national control will lose their only real argument.

Electricity Supply to the Small Householder

Paper read by J. W. J. Townley, A.M.I.E.E., on Thursday, May 31st

THE object of this paper is to advocate the desirability of developing the supply of electricity to the small householder, who occupies five rooms or less. This class represents 70 per cent. of the population with a total potential annual consumption, based on the modest figure of 1,250 kWh per family per annum, of 9,854 million kWh. At an average price of 0.75d. per kWh this represents an annual revenue of £30.75 millions. The total sales by the industry for all purposes was 11,115 million kWh in 1933.

At least 80 per cent. of this class of family can be supplied from existing, or by commercially practicable development of existing, distribution systems. Some of this load is being obtained in some areas very rapidly indeed, and the author maintains that the expenditure involved brings in a reasonable return to the industry. The small householders' spending powers are very limited, and to make them profitable consumers the first step is to offer assisted, or hired, wiring schemes. Tabulated figures illustrate how effective such schemes are.

The mains-operated wireless receiver is a new ally which has influenced many people to install electricity in their homes. A recent census in the author's area shows that 14,000 such sets are in use. Assuming an average loading of 50 W, the total load connected is 700 kW, and is increasing rapidly. In many cases investigated by the author the consumption of the wireless set exceeds the energy used for lighting, and he estimates the revenue from this use alone to exceed £6,000 per annum. Help in locating and suppressing electrical interference with broadcasting should be regarded as a duty rather than an additional burden. It is a service to consumers which will reap a rich harvest.

To obtain the desired average annual consumption it is essential to develop the widespread use of such applications as space heating, water heating, and electric cooking, and of these, cooking offers by far the greatest advantages. Each cooker represents an average additional consumption of over 1,000 kWh per annum; the public is now fully alive to the advantages of electric cooking and will adopt it in preference to other methods if suitable arrangements are provided by the supply undertaking.

Charges and Their Collection

The obvious comparison made by the prospective consumer is with the gas cooker, and in many areas the hire charges for electric cookers are substantially greater than for gas cookers. In addition, a charge is often made for wiring to the cooker. This is fundamentally wrong, although it may be scientifically correct. In order to obtain the business some part of the actual apparatus and installation costs should be covered by the charges for current.

A two-part tariff with a running charge not exceeding ½d. per kWh will be suitable for a proportion of small consumers, but its equivalent must also be available through prepayment meters. No attempt to deal with the problem of

supply to the small householder can be successful which does not provide a satisfactory prepayment system. Tariffs involving the use of two meters, two rates per unit (a high and a low rate), and the complete separation of the consumers' circuits into two parts should be avoided. Rebates from prepayment meters should also be avoided whenever possible.

The author favours the collection of the fixed and hire charges with the house rent or by a collector, and the use of a simple prepayment meter for the running charge only. This method is not, however, generally applicable. If consumers can be grouped for allocation of the cost then an equated rate based on the two-part tariff and the average consumption of the class of consumer served has advantages, the kWh price covering the standing charge and the hire charges being collected by a simple prepayment meter. Though this method may be theoretically unsound, it has proved to be very popular because of its simplicity. Tabulated figures illustrate the results of this form of tariff in the author's and neighbouring areas. The effect of the penny all-in rate in attracting new cooker users is clearly shown by the figures.

For the consumer who wishes to use, or extend the use of, items which cannot be included in this tariff and yet desires to retain the advantages of prepayment, the author suggests the use of the two-part tariff meter, step rate meter, or periodical collection of fixed and hire charges plus a simple prepayment meter to collect the running charge. The basis of the charge for domestic supply should be the undertaking's two-part tariff, but a variety of methods should be used in applying it. No one method has yet been found which will apply to every class of consumer, or even to similar classes in different areas.

Cost and Revenue

The effect of supplying large numbers of small domestic consumers upon the undertaking's peak demand determines, largely, whether the load will be profitable or not. Fortunately, all domestic apparatus (with the probable exception of fires) has a large diversity factor. In provincial towns this diversity in domestic supply is at a maximum, but London, with its tendency to segregation of the various classes into separate areas, is not so fortunate. There is an argument here in favour of larger distribution and selling areas.

Conclusions drawn from many investigations are that the maximum load per cooker occurs on a Sunday and does not exceed 1,000 W per cooker installed; that the week-day load per cooker is substantially less than this figure; and that the load per cooker coincident with the system peak is not more than 200 or 250 W. The average cost per kWh of giving supply to this class of consumer is unlikely, generally, to exceed about 0.7d. per kWh.

Calculations indicate that the return on the sale of energy will be reasonable and beyond doubt if the average consumption per household exceeds 1,500 kWh per annum. It is essential to remember that existing networks are, in many cases, far from being fully utilised and that the acquisition of the additional business will entail in such cases only a very small increase in expenditure.

The actual cost of making provision for a large domestic load when laying new mains in urban areas is remarkably small. During the last five years West Ham has spent approximately £230,000 on low-voltage distributors, mainly of a cross sectional area of 0.15 sq. in. and 0.3 sq. in. If mains of a cross sectional area of 0.06 sq. in. and 0.1 sq. in. had been substituted, then the reduction in cost would only have been about £35,000; that is, the necessary provision on distributors for the domestic load has been made by an additional expenditure of about 15 per cent.

Tabulated figures show that the revenue to be obtained per mile of distributor in poor class districts, with rows of terrace houses, can be as much, if not more, than in comparatively well-to-do suburbs, with their widely separated residences, although in no case has the author yet found that the limit of development of the load in streets of small houses in congested areas has been reached.

Equipment in New Houses

The main difficulty is that the small householder has to bear the capital charges, in some form or another, on his electrical equipment, this equipment in many cases merely replacing equipment originally provided in the construction of the house and already included in the rent. It is of vital importance, therefore, to ensure that all new houses and particularly the 285,000 houses being constructed under slum clearance schemes are properly equipped with electrical appliances by the builders or the housing authorities. Before the advent of domestic electricity supply, wash boilers and coal cooking ranges would have been built in as a matter of course and one or more small coal fires installed in the bedrooms. The substitution of electrical appliances does not alter the responsibility of the builder or the housing authority for the provision of these facilities.

[*Walter Scott, Bradford*

Mr. J. W. J. Townley is engineer and manager of the West Ham undertaking

In the author's area 221 houses are now under construction, of which 120 are being equipped with one coal fire in the living room, one or two fixed electric fires, an electric cooker, and electric wash boiler. Electric lighting is being provided in all the houses. The architect was able to show an average saving of over £16 per electrically equipped house as compared with gas equipment.

The author is convinced that the most suitable equipment for the class of consumer considered is a house with at least one coal fire, in the living room, with a small boiler attached to it. It may reduce the consumption of electricity, but the combination reduces the total cost to a figure within the means of the tenant, and provides a sufficiently large consumption of electricity to make the proposition an economic possibility.

The President-Elect of the I.M.E.A.

MR. EDWARD ERNEST HOADLEY, M.I.E.E., the vice-president of the I.M.E.A., was born at Rochester on October 24th, 1874; thus a man of Kent succeeds a Kentish man. After leaving Sir Joseph Williamson's Mathematical School, Rochester, he received an engineering training at Finsbury Technical College, where he became Salomans Scholar in 1894. His early practical work included experience with the Chatham, Rochester and District Electric Lighting Co. (now the Kent Electric Power Co.), and the Eastbourne Supply Company.

On the opening of the generating station of the Vestry of St. Mary, Islington (now the Borough Council undertaking) Mr. Hoadley became charge engineer; from there he went to Worcester Electricity Department as chief assistant, then becoming resident engineer during the construction and mains laying of the Barking U.D.C. undertaking, of which he ultimately took charge.

Immediately prior to becoming engineer and general manager of Maidstone Corporation Electricity Department in 1901, Mr. Hoadley acted as city electrical engineer at Worcester for eighteen months during the illness of the late Mr. Sutherland.

Mr. E. E. Hoadley

During the past thirty-three years the Maidstone undertaking, like others, has developed beyond the recognition of those who knew it in the early days of the century and the supply has extended into the neighbouring villages over an area having roughly a six-mile radius from the centre of the town. For all the extensions entailed Mr. Hoadley has been responsible, and he designed and constructed the present 15,000-kW station which has been selected for operation under the grid scheme. Sales are about 30 million kWh per annum, including supplies to the tramways and trolley buses. The load factor is over 45 per cent.

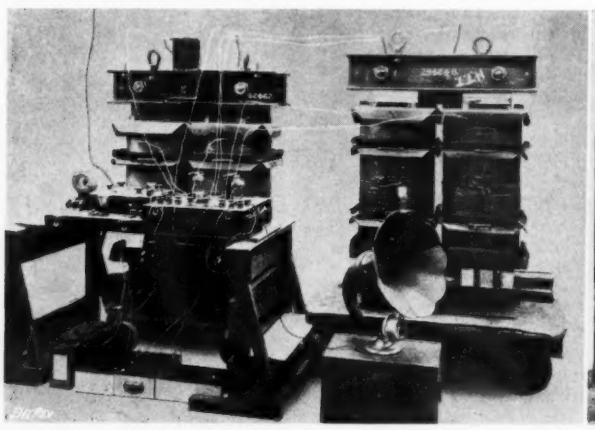
Mr. Hoadley has long been associated with the government of the I.M.E.A., having served three periods on the Council. He has read four papers at the Conventions, including that which he gave last year, in conjunction with Mr. P. J. Robinson, on electric cooking, another aspect of which he dealt with in an article which he contributed to our columns on January 19th of this year. Mr. Hoadley is a member of the Council of the British Electrical Development Association and is also the chairman of the Electric Cooking Committee of that body.

Radio and Electrical Development. By V. Z. de Ferranti

MANY of us whose early training was concerned with the heavier side of engineering, and who have grown up with our aims concentrated mainly upon electrical power development, have been inclined in the past to look upon the youngest branch of electrical science with something of an air of detachment just tinged with condescension.

How often has one heard the electrical power engineer protest, almost with pride, that wireless was a subject of which he knew nothing. Often the boast was far from true, and there may sometimes have been in it an instinctive gesture of self-defence against the demands of friends and relations upon his time. His knowledge of the subject frequently was considerable, but it was apparently felt not to be in any way associated with his job.

Now, however, the electrical power engineer, justly proud of the service which he is able to render to the public at large, and ever watchful for the means of widening this service, recognises in the growth of wireless a public service allied to that of electric light and power, and similarly indispensable.



Left: Power transformers used in a three-valve set. Right: An ultra-modern receiver

In its technical development radio, of course, owes a great deal to the earlier work of the electrical power engineer. One interesting example of this is afforded by the accompanying illustration taken about ten years ago. It shows an experimental demonstration in which two power distribution transformers of 150-kVA capacity were made to serve as inter-valve transformers in a simple three-valve wireless receiver, and it reminds us that the low-frequency wireless transformer is basically the same as the power transformer despite their difference in size.

Other similar points come to mind, but the indebtedness in this relationship between radio and electrical development is by no means a one-sided thing. The commercial benefits derived by the electricity supply industry from the public interest in radio are very great. Radio has developed in many people a high degree of electrical-mindedness and has done much towards banishing in the minds of others, with regard to electricity, a slight fear of the unfamiliar, which has in the past been a definite hindrance in the path of progress.

A Desirable Load

Supply engineers are familiar with many small household consumers who have availed themselves of the supply, primarily in order to be able to use it for their wireless sets. Individually a small load, it is true, but once the supply is in its wider advantages are soon recognised and turned to good account. Moreover, the six million or so holders of wireless licences in Great Britain to-day may be presumed to represent, perhaps, two and a half million mains-operated sets: that means a connected load of the order of 150,000 kW. It is probably in demand for an average of two hours a day—using about 90 million kWh per annum—and that almost entirely outside the hours of peak demand. Thus the commercial value of the load due to wireless in itself is seen to be considerable.

It is becoming a vogue for electric clocks to be incorporated in wireless sets and this is one of many directions in which wireless is helping quickly to foster the electrical idea. Generally, it must be agreed that the needs of wireless are worthy to be considered as a factor in the development of public electricity supply and, in this connection, a plea might be made for hastening the change-over of all existing d.c. distribution systems to a.c.

From the consumer's point of view, a.c. presents so many advantages—particularly in the home—that no obstacles which can reasonably be overcome should be allowed to stand in the way of providing it. The change-over should be made, wherever possible, both in the general interests of standardisation and because a.c. appliances are usually cheaper and more satisfactory in operation. It would be a kindly thought for the wireless user and a real blessing to the wireless manufacturer if, at the time of a change-over from d.c. to a.c., the consumer's attention were drawn to the desirability of having his house-wiring switches, fuses, &c., carefully overhauled. The modern wireless set with its very large amplification, reproduces the effect of every small leakage in the wiring system, or incipient arcing due to improper contact in switches or fuses.

It is well known how badly corroded the contacts throughout the average d.c. house become after a few years' operation. This probably causes no inconvenience in the running of lights and the usual domestic appliances, but for the modern radio set it is hopeless. The horrible noises reproduced by the loud speaker of a radio receiver installed in such a house are often attributed quite wrongly to some fault in the set, and it is left to the radio manufacturer, through his service engineer, to inform the householder that the wiring needs to be thoroughly overhauled to enable the radio set to be used.

Better Installation Work Demanded

The effect of faults in wiring, switches, &c., moreover, is not confined by any means to the house in which they exist, and serious inconvenience to radio users is frequently caused by faults of this nature in neighbouring houses. Radio thus demands a better standard in the condition of both new wiring and old than is strictly necessary for other purposes, and this, it will be agreed, is all to the good in the interests of safe and satisfactory electrical development.

Interference is also caused to radio reception by many electrical appliances. Possibly one must have lived in an all-electric house to realise how very annoying this interference can be to the radio listener. It sometimes seems that every item of current-consuming equipment is taking part in a conspiracy to make radio reception impossible. Mains-operated bells; the children's electric toy train; perhaps an uncertain contact on an electric fire; and, worst of all, practically any piece of equipment driven by a motor. The disturbances are transmitted to the receiver both by radiation and through the house wiring, and naturally, their influence extends to neighbouring houses. It needs no emphasis to show how serious this is to the interests of radio development, but it may also retard electrical development.

Mr. V. Z. de Ferranti is chairman of Ferranti, Ltd.

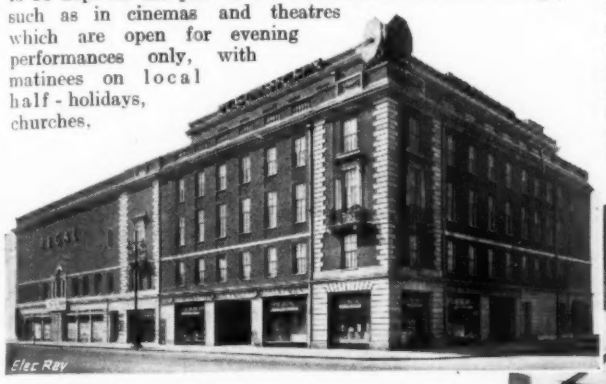
The problem of dealing with this electrical interference is receiving the attention of an influential committee, but the success of their efforts requires the co-operation of all who are concerned in the matter. It is far easier to supply equipment which may be relied upon not to cause interference than to eliminate interference due to equipment already installed, which is sometimes an expensive matter.

Radio and public electricity supply are two branches of the electrical industry with so much in common that a great deal might be done for their mutual benefit by the establishment of the fullest possible sympathy between them. The ways of both would be made easier, and, as a consequence, there would undoubtedly be a far more rapid development in both branches.

Heating Large Buildings. By J. N. Waite, M.I.E.E.

THE heating of large buildings by electricity is now an economic proposition, both for the owners of such buildings and for the electricity supply authority. A number of outstanding examples have been in existence for many years, and the number is growing, but it is probable that many supply authorities do not realise how low a rate can be offered profitably for such a load.

To permit an attractive tariff to be offered, it is essential that this heating demand should be "off-peak." Thermal storage enables this essential to be obtained, although there are many cases where the conditions of use enable the demand to be kept off the peak without recourse to thermal storage, such as in cinemas and theatres which are open for evening performances only, with matinees on local half-holidays, churches,



elementary schools, dance halls and other buildings.

Whilst the idea of supplying heat during night hours only is very attractive, it must not be forgotten that the shorter the permitted hours of use of the supply the greater the cost of the heating installation, and the high capital charges involved may tend to evoke a decision against electricity. If the load curves of a normal undertaking are studied, it will be seen that the real peak hours are relatively few. In normal cases, high peaks do not commence until towards the end of November and are disappearing again by the middle of January. Outside peak hours there exists plenty of unused capacity, both of generating plant and mains, and therefore any off-peak heating load which can be obtained involves very low capital charges; such capital charges are confined generally to the actual expenditure in coupling up this load, thus bringing about the attractive position of a relatively large consumption for a relatively low capital expenditure.

In framing tariffs for large scale heating, it must be remembered that, apart from coal cost, all other costs are governed by the demand made at the time of the winter peak load. An illustration of the cost of an off-peak heating load to a "selected" station undertaking is given in the table.

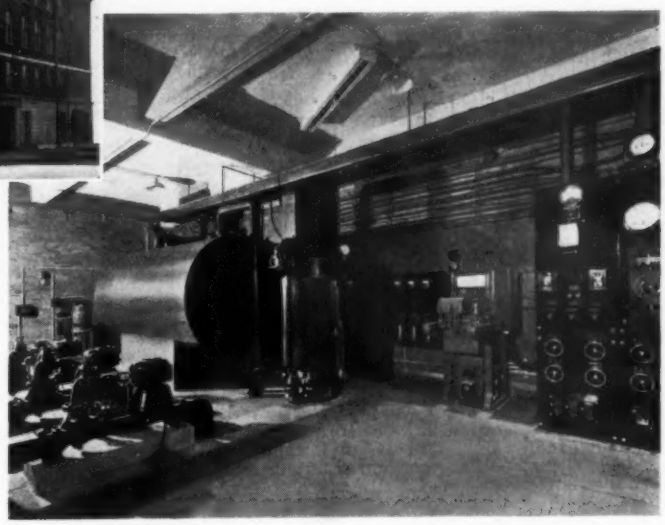
Undertakings receiving a bulk supply will not be so fortunately situated, but the economic facts remain the same, and there appears to be no reason why they should not be able to obtain a special low follow-on rate for kWh sold for large-scale off-peak heating load.

Mr. J. N. Waite is city electrical engineer and manager of Hull

Heating consumers will also require lighting and/or power and cooking. It will be obvious that capital charges must be less for a combined load than for the various classes of load singly, and therefore, some concession on normal rates is justified for these other uses. An attractive form of tariff for large scale heating and other supplies combined is a lump sum payment per annum, based on lighting and power demand at the appropriate rate per kW or kVA, and a low follow-on rate that is common to all supplies. With this form of tariff the metering equipment consists merely of a watthour meter or meters, and a time switch to control the heating circuit. The tariff is understood easily by the consumer, it gets rid of irksome restrictions, obviates the necessity of separate wiring for different purposes, enables any justifiable reduction made on other supplies to be used as a credit for the heating cost, and, above all, it is attractive to the consumer and encourages use of the supply.

For large consumers, separate tariffs for different purposes are an irritating anachronism, and should be abandoned as early as possible in favour of a two-part tariff to cover all supplies, with the values of the fixed and running components adjusted to suit the conditions obtaining in each consumer's installation, the running component being really low enough to encourage extensive use. I have adopted this method extensively with considerable success.

It is obvious that the costs of giving, say, a lighting and power supply to one consumer are less than when giving a similar lighting supply to one consumer and a similar power supply to another separate consumer. The rate of progress of any class of supply depends primarily on the tariffs offered, and secondly, on the method of dealing with the consumers. Slavish adherence to methods of charging which might have been justifiable many years ago, but which are no longer so, are a definite hindrance to development; the most irritating and useless of these methods is to insist on applying rigid separate tariffs to the large consumer for different classes of supply. The best method of getting the heating load of large buildings is to offer an attractive all-in tariff, covering all purposes of the consumer. (In this case, tariffs really mean the financial terms in special agreements.) When this is done there is a reasonable chance of developing electricity as the sole source of energy.



The Hull Corporation electricity offices and showrooms and the "Regal" cinema. This block has a cubical content of 1.65 million cu. ft. The thermal-storage heating plant at the electricity showrooms is illustrated

OFF-PEAK HEATING LOAD COSTS

Consumption per annum, kWh		500,000
Coal cost per kWh sold		0.09d.
Distribution expenditure to connect up load		£1,000
Cost to Undertaking:		
Coal 500,000 at 0.09d.	£188	
Capital charges at 8 per cent.	80	
Total	£268	

Average cost per kWh: 0.129d. plus a small amount for overheads.

The heating of buildings on a large scale offers an immense market for low priced kWh, and renders possible the utilisation of capital locked up at present in generation and distribution capacity, which is earning revenue for only a few hours per year during the winter peak. Any use made of this capacity during other than peak hours must have a beneficial effect on the cost of the general supply.

The purists may argue that if this off-peak heating load is developed sufficiently, the real reasons for the low price will disappear. As the normal winter peak is 50 per cent. or more in excess of the normal day load, it is going to take many years to get this off-peak excess capacity loaded up, and when that time comes—if ever it does—there will be no great difficulty in adjusting our business to the new conditions. Large scale off-peak heating offers a good field for the utilisation of, at present, idle capacity, and it may be emphasised that the most effective way of reducing costs is to sell more kWh per pound of capital expenditure.

The Warming of Factories. By H. P. Barker

Great potentialities in an almost untouched field

IT is a source of surprise and perhaps disappointment to many that the use of electricity for warming factory buildings and workshops has not attained to wider usage in recent times. The supply engineer would like to have the load, for it has a good load factor, encroaches only negligibly on the evening peak, and enables him to use more profitably the substantial service cables available in industrial areas. The revenue is constant, predictable and the degree of peak incidence can be readily assessed.

The contracting engineer has, in the electrical warming of factories, a hitherto entirely untouched market which is at present the playground of gas, steam and hot-water heating. *Prima facie* there appears to be a number of excellent reasons why the industry should go out and sell this particular service, but, before summarising the selling point, advantages and methods commonly employed in modern electric heating practice, I would warn readers to recognise the type of factory which presents a good case for electric heating and that which does not.

[*Mesdames Morter*

Mr. H. Purslove Barker is a director of Unity Heating, Ltd.

In general, it can be said that if the nature of manufacture carried on requires substantial quantities of process steam (which cannot be supplied electrically) then, unless there are exceptional circumstances, a good case on cost cannot be made for the adoption of electric space heating when there is presumably so much heat in the form of process or waste steam available for this service. If this commercial disability to the electrical case does not exist, then, presuming a reasonable electricity rate is available, a very strong case indeed should exist for the adoption of electricity on the following grounds.

1. The use of electricity will enable sections of the factory to be run independently of the remainder during overtime periods, &c.
2. Thermostatic control will prevent the overheating which frequently occurs in factories where heavy plants, giving out a large quantity of waste heat, are installed.
3. It is possible to arrange an electric heating installation so that no floor space is taken up.
4. The installation itself is a flexible one, and, in the event of modifications in factory lay-out, the heating plant can readily be rearranged to suit the new conditions.

With steam heating, either by radiators or a plenum system, it it often a difficult and serious matter to have to arrange pipe trunking in the event of a department being moved or a partition erected.

An Economical System

Running costs are very reasonable. This is partly due to the considerable amount of incidental heat generated in the factory itself, either by machines and equipment or personnel. Partly also because in a plant of reasonable size the installation can be accurately controlled and all wastage, due to overheating or heating at unnecessary periods, can be abolished.

Owing to the relatively small amount of work which has been done in this field it is not possible to comment upon common practice regarding the type of equipment employed. It will suffice to say that the methods which have been used with the greatest possible success have been as follows :—

a. Heating by means of a combination of high temperature panel radiators mounted on the piers and in the room of a "saw-tooth" factory combined with tubular heaters at low level under benches giving very even distribution.

b. Thermal storage heating combined with either plenum air distribution, unit steam heaters or hot water radiators. In this category one might expect to see a number of thermal storage cum plenum installations in the future.

From the point of view of the supply company or contractor anxious to secure this class of business it may be said that between the end of August and the beginning of November opportunity is at its maximum. In addition to the warming of large factory buildings operated by substantial concerns, there is, in London especially, a very large market for electrical warming as a supplementary system to augment the unsatisfactory and inefficient existing systems in the many small factories and workshops which abound.

The factory inspector is the best friend that electricity has, for he knows only too well that the number of factories in which large numbers of operatives are permitted to work under conditions of extreme discomfort is still considerable, and the heating salesman may expect considerable business in the wake of the unpopular edicts of this ubiquitous official.

Over-elaboration to be Avoided

In the past a large number of otherwise profitable and favourable factory heating propositions have fallen through owing to manufacturers and supply undertakings having placed before prospective customers projects which were too elaborate and, in many cases, designed to promote results far better than either the exigencies of the situation or the depth of the consumer's pocket would permit. It is worth remembering that in warming factories, in most cases owing to the manual work involved, a very much lower state of comfort is required than would be necessary in, say, schools or an office building.

Further to this, as has been mentioned previously, the incidental heat derived from machine tools and running plant is considerable, and, in fact, is frequently sufficient to warm the building when the initial state of comfort has been raised to an appropriate point. Thus the provision of thermostatic control, which is so easily applied to an electric heating installation, will result in a very considerable saving of energy — and consequently of cost. This should prove a strong selling point.

An example of panel heating installed in a factory

The reader may wonder why I have not dealt more extensively with the methods which are actually employed in effecting the warming of buildings of the class under consideration. The reason is that owing to the very small amount of work which has been done in this field, there is, as yet, no "common practice" and that at present the difficulties lies not in *doing* the job but in *selling* it. To discuss the first and be incapable of the second would be idle.

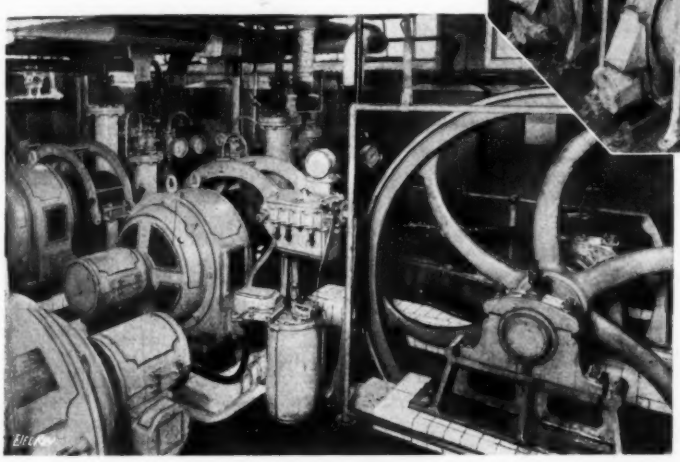
The intensive co-operation of manufacturers and supply undertakings is urgently required if this field of activity is to be the subject of further investigation and exploitation. It is to be hoped that when the supply industry realises the immense business which there is to be done in this unexplored field, the manufacturer will not be slow to provide the equipment and organisation necessary successfully to implement the imposing category of merits which supply authorities, in the light of even present data and experience, may confidently put forward to their consumers.

The Electric Motor in Industry. By W. Y. Anderson

IT is only when figures are available showing the very large quantity of electrical energy sold for industrial power purposes in various parts of the country, that the important part which the electric motor plays in the modern factory can best be appreciated. It follows that sales engineers of electricity undertakings supplying industrial centres must devote considerable attention to the development of this valuable load. It is my purpose in this article to enumerate briefly a few of the problems which are encountered.

Technical knowledge should be possessed by every member of the commercial staff dealing with the power load, as many questions of an engineering nature are met with and have to be satisfactorily solved if the highest efficiency is to be obtained. It is, for instance, essential that the right type of motor should be chosen, that the running speed should be correct, that the best arrangement of drive should be made, and that the general layout should be such as to ensure the maximum efficiency and greatest convenience in the factory.

The heaviest charge that a manufacturer has to face is usually the wages bill, and the power arrangements should be designed as far as possible to affect the wages account rather than the power account. A well-planned power scheme will often increase the output for the same wages bill and will also cut down expenses by saving material, and minimising wear and tear and other maintenance charges.



Motor drives in the Midland Counties Dairy. Left, refrigerating plant; right, homogenisers, which effect an even distribution of cream in milk

If line shafting is to be driven, careful attention should be given to its condition, as shaft hangers out of alignment, old type bushes, and shafting of a very small cross section often give a bad drive, and are faults which absorb a large proportion of the output of a motor. Given improved and efficient power transmission it is frequently possible to install a smaller motor without reducing the number of machines to be operated.

When a motor has to develop its maximum output at low speed immediately it is switched on, as when it has to start a long line of shafting in a machine shop, it is sometimes advisable to install a motor with a high starting torque, such as the slip-ring type. This method frequently saves the installation of a larger machine than is required to deal with the running load, as might be done if a motor with a low starting torque were installed. In a case that came to my notice, a 20-h.p. squirrel-cage motor operating line shafting in a polishing shop was not giving satisfaction. This machine was exchanged for a slip-ring motor of similar horse-power, and no complaint has since been made.

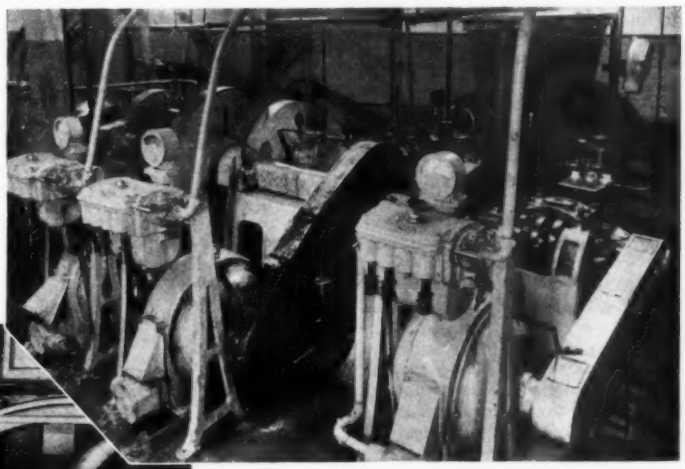
Consideration should also be given to the conditions under which a motor has to work. A motor running in a dirty atmosphere, for instance, should be of the totally enclosed type, to avoid risk of failure through the presence of foreign matter in the stator and rotor windings. Again, motors should not, for obvious reasons, be fixed in very damp places.

Industrial Knowledge Necessary

In order to design a successful power scheme for a works, an engineer must have some knowledge of the trade or manufacture carried on, and of the working conditions. The works engineer can often be made a most valuable ally, and much useful information will be obtained from him.

It is not advisable in all cases to install the most efficient mechanical arrangements regardless of cost. The subdivision of shafting and individual driving of machines will frequently reduce energy consumption, but the capital cost of such arrangements cannot always be justified. It is sometimes cheaper to consume a little more electricity and save capital outlay rather than to make expensive mechanical alterations.

The obtaining of load curves sometimes appeals to manufacturers. The owner of a rolling mill once assured me that the large number of rolls driven by his engine resulted in a steady load, and that his steam engine was therefore working at high efficiency throughout its run. A continuous indicating diagram was taken which showed that the load varied from 70 to 215 h.p. with the result that the steam plant was discarded in favour of an electric motor.



The running of plant with a low power factor not only shortens the life of motors through overheating, but also adversely affects the carrying capacity of the supply mains. For these reasons many undertakings offer special discounts to large industrial consumers for improved power factors, and others impose penalties for poor load factors.

A very careful examination must be made of the running conditions before a decision is made as to the method of improving power factor.

As an example, a factory with a number of medium-size motors driving line shafting, but with an intermittent load, would not show a good power factor over the whole installation. In such a case a considerable improvement may be shown by grouping several lines together and installing a highly rated p.f. correcting machine.

Mr. W. Y. Anderson is commercial engineer in the Birmingham Electric Supply Department

In some cases, it may be desirable to install an auto-synchronous motor instead; in others the improvement may be made by the installation of a bank of condensers, or an exciter.

A manufacturer, when estimating the cost of running various forms of power, often bases the cost of electric driving on figures obtained by multiplying the full load consumption of the total plant to be installed by the working hours. This gives a very high consumption, and is usually misleading. It does not take into account the many economies effected by the introduction of electric power, such as the saving in shafting losses or the splitting up of drives which reduce the running hours.

It is difficult in most cases to calculate accurately the value of these advantages. The best way to estimate the costs is to give the average kWh per horse-power consumed in working conditions by a selected number of firms in the same trade.

The maintenance charges of electric motors in comparison with other forms of power are very low. Large firms usually

employ an electrician to look after the plant and keep it in order, while in the case of smaller firms many contractors will undertake the periodical inspection and maintenance of motors, etc., at a small annual charge. The number of a.c. motors connected is rapidly increasing owing to the standardisation of supply systems; as these have no commutators or carbon brushes to require attention they show a saving over d.c. machines.

The greatest opposition that the power engineer has to contend with is that of the advocates of oil plant. In meeting this, after the advantages of electricity from the public mains have been emphasised, a statement should be prepared showing the costs of the rival schemes. On one side there is the price of electricity, interest and depreciation, and repairs and maintenance. The figures for oil plant should include oil for fuel and lubrication, water, stores, etc., attendance, repairs, maintenance, insurance, management and supervision, interest and depreciation. It can then usually be demonstrated that the cost of electric power is 80 to 90 per cent. of the total annual costs, but the cost of oil fuel represents only approximately 25 per cent.

Reliability is often a determining factor. If private plant is installed adequate standby must be provided to avoid risk of a complete shutdown in case of failure, and to permit of increase in load if business expands.

A final argument is that conditions of labour and employment in electrically equipped factories are usually much superior to those equipped with other forms of power; the quality of work turned out is better; losses due to rejected articles and waste material are reduced; and output is increased. With these, and the many other advantages in its favour, the electrical salesman should have confidence in his goods, and have little difficulty in gradually overcoming the obstacles in the road to complete industrial electrification.

Glass Annealing. By S. E. Monkhouse, M.I.E.E.

APART from the application of electric heating to processes associated with the manufacture of ferrous and non-ferrous metal products, there are many new developments in other branches of industry. I have chosen one of these, namely glass making, for description in this article as a good example of the direction in which the use of electricity in the form of heat is progressing.

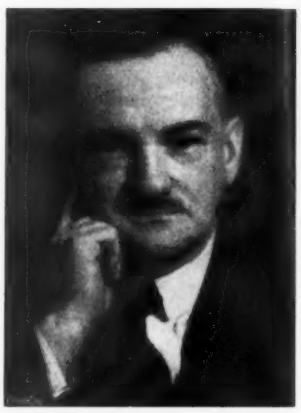
Glass making is typical of an old industry in which modern science is being linked with experience accumulated by practice and tradition over past centuries. Glass is a complex substance which differs from a metal in that it has no crystalline structure, and consequently it obeys different laws during heating and cooling. It has no defined melting point, such as metals have, but changes gradually from a solid to a plastic.

It is worked to the required shape whilst in a plastic condition at a temperature between 700 deg. and 1,000 deg. C., and scientific investigation has shown that the fractures hitherto so often found in the cooled material have been produced by strains set up during moulding being relieved too rapidly by the subsequent cooling process being carried out too quickly. It has been found that these strains are relieved at different rates depending on the time at which the article to be cooled is maintained at a certain temperature.

For instance, with a particular glass the strains may be completely relieved in ten minutes if the moulded article is maintained at a temperature of 630 deg. C., whilst 4½ hours would be required if a temperature of only 30 deg. less were maintained. The higher temperature is very near to the point where the material starts to become plastic; hence if the strains are to be released in the shortest possible time accuracy of temperature control is a vital factor.

A short description of a typical fuel-fired glass-annealing lehr will show how impossible it is to maintain a high and even temperature with any degree of certainty. Such a lehr consists of a substantial brick chamber about 60 ft. long provided at one end with a furnace and so arranged that the products of combustion pass along the lehr to a chimney at the far end, thus producing a decreasing temperature during their travel. The hotter products of combustion naturally travel near the roof, making the upper part of the chamber much hotter than the bottom, a condition which is contrary to the requirements of the process, since glassware is usually thicker at the bottom than at the top.

The discharge end of an electrically heated glass-annealing lehr



Lt.-Col. Monkhouse is assistant general manager of the North-Eastern Electric Supply Co., Ltd.

Any fine control of temperature is clearly impossible under these conditions and, in consequence, the general temperature has to be kept lower than is theoretically necessary and the glassware passed very slowly through the lehr in order to provide an ample margin of safety for correct annealing. In a furnace of this type, the brickwork tends to deteriorate and, should a fine crack develop in it, a draught of cold air is drawn in on to the hot glassware, much of which is broken as it passes the crack.

To overcome these difficulties a glass works supplied by the North-Eastern Electric Supply Co., Ltd., installed an electric lehr about two years ago. It consists of a comparatively light sheet-steel structure about 60 ft. long, carefully heat insulated over rather more than half of its length and constructed so that it is free from the possibility of draughts. The first 20 ft. of the lehr is arranged into four separate 5-ft. heat zones, each fitted with 10 kW of electric heaters and automatic temperature control, so arranged that, throughout the whole length of the lehr, the temperature difference between the top and the bottom is small.

The first zone is maintained at the upper annealing temperature and in this zone the strains caused in manufacture are released, and the subsequent zones are held at progressively lower temperatures so as to take the glass through the critical annealing range. The ware is carried down the lehr on a light steel woven-wire belt, driven by a small motor through variable reduction gearing, and leaves in a perfectly clean condition free from the sulphur bloom which is obtained in all fuel-fired lehrs, and which has to be removed by washing before it can be despatched. The illustration shows the discharge end of the lehr. The asbestos curtain is at the end of the annealing chamber and is provided to allow a free passage for the glassware, and at the same time to reduce the amount of cold air which can enter the chamber.

This lehr has operated without any trouble whatever since it was installed two years ago. The results of a typical week's working show that during a period of seven consecutive days, including 5½ working days, 55,427 lb. of glassware are passed through the lehr, with a consumption of 2,360 kWh, over half being taken during the night and week-ends.

The lehr has reduced spoilage in annealing by at least 5 per cent. and by reason of the satisfaction given by its reliability, further lehrs are now about to be installed in the same works.

Industrial Lighting. By H. C. Wheat, A.M.I.E.E.

THAT the importance of adequate lighting of factories and workshops is not appreciated by the majority of factory owners and engineers is obvious to anyone who has had an opportunity of visiting an industrial area and going over such premises during artificial lighting hours. It does not require an expert to realise that the gloomy and depressing surroundings cannot be conducive to a suitable "atmosphere" among the workers, and that the light does not enable them to see well and quickly the work which they are doing.

[Fox Photos

Mr. H. C. Wheat is the chief illuminating engineer of the Edison Swan Electric Co., Ltd.

The factory management is prone to look upon lighting as a necessary evil and good lighting as a luxury which it cannot afford, but this view is not justified in practice. In the first place, the cost of lighting is one of the smallest items in the overhead charges — probably less than 1 per cent. in most cases and the relative effect on the total is practically negligible—yet with good lighting the morale of the workers is vastly improved, which unfortunately can scarcely be expressed in terms of hard cash, the output is increased, the number of errors reduced and the risk of accidents lessened. The last fact alone would, one imagines, be a sufficiently convincing argument to convert most people, considering the vast sums that may be (and frequently are) involved, quite apart from the lost time and disorganisation that results when an accident occurs.

That output and errors are directly connected with the lighting has been definitely proved time and time again. While much of this information remains the property of a particular factory management, results have been published from a number of independent sources, all telling the same story, which should be sufficiently convincing to convert the most sceptical. The average of a number of results taken together shows that by increasing the illumination by 160 per cent. the output was increased by 13.54 per cent.

Now assuming that the operating charge for the original lighting was 1 per cent. of the total overhead charges in the first instance, it would, pro rata, become 2.6 per cent. on the higher basis. What factory manager could afford to neglect an increase of 13.5 per cent. on his output for such an insignificant increase on his overheads? Would he hesitate if it was a question of replacing existing plant by new machines?

Neither of these figures would apply to every particular factory. Probably a very much greater increase in the illumination could be justified in many cases, but it does not follow that the cost of operating it would increase at a similar rate. If, for instance, naked lamps were in use, the effective illumination might be increased three or four-fold by simply installing effective equipment with the same size and number of lamps, which would not increase the operating cost at all. Some of the essentials that contribute to good lighting follow.

First, there must be ample illumination for the particular class of work or operation that is being performed. The finer and more accurate the work, the higher the level of illumination required. It may be possible at no very distant time to calculate the illumination necessary for any particular visual task, but in the meantime there are schedules available giving the level of illumination that has been found desirable in practice for a very large variety of industrial operations.

To lay out an installation to give such results in the usual type of factory building presents no difficulties to anyone accustomed to such work, or, indeed, to any intelligent person who has access to the necessary data (which is now available in many publications) though experience will be of considerable assistance in avoiding mistakes which might otherwise be made and also in knowing the best form of equipment to employ for the purpose in view.

Horizontal and Vertical Illumination

It should be noticed that illumination is usually based on an average value on a horizontal plane at the level at which the work is carried on, but it must not be overlooked that many, if not most, industrial operations also require illumination on vertical surfaces, for which adequate provision must be made. (It is theoretically possible to provide good horizontal illumination without any illumination on vertical surfaces).

Glare either from inadequately shaded lamps or by reflection of lamps from polished surfaces must be avoided, because the human eye functions at a disadvantage under such conditions. Harmful glare can be avoided by the use of proper equipment correctly placed—largely a matter of experience. Hard dense shadows should be avoided; they not only interfere with proper vision, but are liable to cause accidents. Such shadows can be avoided by the use of suitable equipment, properly placed. Experience is probably the best guide.

Left: The finishing department of a hosiery factory. Right: The woodworking mill of Morris Commercial Cars, Ltd.

Effective maintenance is necessary to keep lighting installations in good condition. The accumulation of dirt soon reduces the effectiveness of any lighting equipment and a first-class installation may become mediocre if proper maintenance is neglected. Thorough cleaning of equipment and replacement of lamps should be carried out at regular intervals. It will be seen from the foregoing that effective lighting depends on the employment of adequate sized lamps in suitable equipment correctly positioned. It is impossible, in the space available, to define in detail the size of the lamp and type of equipment suitable for all the different classes of industry, even if the size and type of building in each case were known. Each case should be considered on its merits. The following remarks may, however, be of service to those who wish to study the subject.

The majority of industrial installations come under the category of direct lighting, in which the lamps should be provided with efficient reflectors to redirect the light towards the work and to provide adequate protection from glare by shielding the lamps from direct vision at angles near the horizontal. Usually general lighting can be effectively employed in which the

lighting units are disposed symmetrically over the whole area and placed at a good height above the ground. The number and size of units are primarily governed by the height available, but it is also affected by the class of work. Comparatively few large units are suitable for rough work, but where the operations are finer, a larger number of smaller units should be employed.

In certain cases, as for instance in textile plants, group lighting is desirable, *i.e.*, the units should be disposed in reference to the machines. In other situations local lighting may be desirable, so as to get the light on the working point, but where local lighting is used, it should always be supplementary to general lighting, which can then be at a somewhat lower intensity than when used alone. In some situations it is desirable to employ units in which the lamps are enclosed in diffusing globes, so as further to soften shadows and to reduce both direct and reflected glare.

Indirect lighting, in which the greater portion of the light is reflected from the ceiling, gives an effect approaching diffused daylight and is particularly suitable for critical work where the eye is heavily taxed. Unfortunately, there are comparatively few factory buildings which lend themselves to this form of lighting, and also there is considerable prejudice against it on the score of physical inefficiency, but where it can be employed it enables results to be obtained that cannot be secured in any other manner and more than justifies any increase in cost of operation.

Whatever system of lighting is employed, it is important that good lamps and equipment shall be used if the best results are to be obtained and maintained. Any increase in the initial outlay is more than compensated by the improved service from the equipment and also from the firms who supply it. Of factory lighting and lighting equipment, it can be truthfully said that the best is cheapest in the end.

Electricity Control. By Clifford C. Paterson, M.I.E.E.

OPPORTUNITIES are constantly occurring for the control of electricity in new ways. New techniques appear but it is impossible for their authors to see any but a few of their applications. Suggestions for applications, therefore, are to be looked for from others who find a need which they think the new technique will satisfy. Let us look at one or two of them.

This type of relay has been rather long coming into its own. Yet it is unique in its powers. The outstanding feature of a thyratron is the copious flow of electrons which it can set up instantaneously at the least provocation. Hence the alternative name, gas-filled relay. It has the usual three electrodes—hot cathode, grid and anode—but it differs from the ordinary high-vacuum valve by having these electrodes immersed in mercury vapour.

If the grid is at a certain negative potential, or in other words has sufficient electrons concentrated in it, these keep back by repulsion the stream of electrons which is anxious to shoot from cathode to anode. Withdraw but a few of these grid electrons by any small external device such as a photo-cell, and the repulsion is reduced sufficiently to allow a few electrons to fight their way from the cathode. So far the action is similar to that in an ordinary valve. But the presence of the molecules of mercury vapour now entirely changes things. For collisions take place with these electrons, and some atoms of mercury lose an electron and become positive. The mercury atom is a great lumbering thing fourteen times more potent, for instance, than hydrogen—and when charged positively in this way it has a catastrophic effect in neutralising the repulsive negative field.

Mr. C. C. Paterson, O.B.E., is in charge of the G.E.C. Research Laboratories

A deluge of electrons thus passes from cathode to anode—for all barriers are then removed—and nothing will stop the spate unless the voltage attracting the electrons from cathode to anode falls to zero. When this voltage is made zero the valve recovers in less than one thousands of a second ready for the next impulse. The quantity of electrons to be extracted from the grid in order to trigger off the device is only of the order of one million millionth of an ampere second. Hence the weak impulses of a photo-cell acting direct on the grid are sufficient to actuate the device.

Furthermore, the promptitude of the response is phenomenal. Wynn Williams causes it to actuate a counter—if necessary fifty times a second—the stimuli being only the little bursts of electrons which result from the energy of a single atom as it disintegrates. An interesting use which employs its powers to full advantage is where, in delicate spot welding, the current flow is only required to be maintained for the time of one cycle of the 50-cycle supply. The thyratron does this naturally and easily. Thus, in the thyratron we have a relay in which the minute energy of 10^{-12} watt-second triggers off in one or two millionths of a second currents of several amperes, and stops them equally quickly when the anode volts are brought to zero.

Extra-high-frequency Valves

Extremely high pulsating currents and the oscillating fields which result are familiar to radio engineers and are used by them for radio communication. The magnetron carries these oscillations up to 3,000 million per second—should this frequency be wanted. But possible further uses of electricity which pulsates at such frequencies are awaiting suggestion from those working in other than the radio field.

The medical profession is finding them promising for raising the temperature locally of different parts of the body. The less the conductivity of the tissue the longer the wavelength appropriate for heating it, according to the rule for leaky condensers. Relatively high-resistance tissue, without a large blood supply to carry away generated heat too quickly, will be the easiest electro-medical problem. The knee joint, for instance, lends itself to internal heating by the agency of high frequency. By this agency the skin over the joint is not heated—it is in the wrong plane; whereas externally applied heat, even radiation, must traverse and heat it. Another application employs an intensely localised effect at the leading edge of a small electrode as an effective substitute for the cutting action in surgery. There may be other uses where semi-conductors or bad conductors need heating in similar ways.

A new method of control of alternating currents for the purpose of rectification is coming to the fore in the form of the Marx rectifier. In this the current is made to jump a gap which would otherwise retain its insulation, by passing a pilot discharge from an ignition coil, much as a spark is passed in a petrol engine to start each explosion. The ignition spark "breaks down" the gap at the beginning of a cycle and the full current follows it up in the form of an arc which, unlike the familiar lighting arc, is not allowed to burn away the electrode.

When, at the end of the half cycle, the voltage passes again through zero, the arc extinguishes itself and does not start again until the pilot discharge again passes. This it does at the commencement of the next forward half cycle. We thus have simple rectification current passing only at the forward half cycles. The advantage of this form of control is that it gives rectification in air without moving parts, and by adjusting the timing of the pilot spark we have the operation under very precise regulation.

It is an interesting innovation to make a gap conducting by, in effect, injecting hot ionised air into it at the right moment. The use of air, compressed if necessary, makes the rectifier available for the highest voltages Hitherto we have contemplated only static arc rectifiers contained in evacuated glass or metal envelopes. Only under these conditions could they be made to strike. But the timed pilot control spark is altering this and is promising the opportunity of static rectifiers without the complication of evacuated enclosures.

Finally there is an interesting development for automatic control in which the desired rate of change is logarithmic. The change of sensitivity of eye and ear with their stimuli—light and sound—are approximately logarithmic, and it may be useful if these can be imitated electrically. Ryall has shown that such a semi-conductor as selenium can be used as a non-ohmic resistance for a galvanometer shunt with logarithmic fall of resistance as the voltage is increased. So the percentage error becomes constant over the whole range of the instrument, and one obtains an ideal shunt hitherto unobtainable by other means. A telephone transmission measuring set is now made on this principle for the use of telephone administrations.

The principle can be well applied also to moving-coil instruments either for use with direct current or else, with the addition of a bridge-rectifier unit, for the measurement of small alternating currents. Such instruments when calibrated in volts or amperes give an approximately logarithmic scale. They can be used to give readings over the whole telephonic frequency scale, and can be calibrated with the logarithmic units employed for telephone measurement. Such scales will then be approximately linear.

Textile Mill Driving

EXCEPT, in some cases, for stand-by and pilot lighting supplies, the whole of the electricity used at the six mills in the Bury area of Messrs. James Kenyon & Sons, Ltd., which are devoted to the production of cotton and woollen goods, is generated at the mills (no doubt because of the appreciable quantity of steam required for process), d.c. at 250 V being employed throughout. The following information relates to two of the mills which we recently visited.

Crimble Mill, at Heywood, is engaged mainly on finishing operations demanding some 400 h.p. This demand is met by a Musgrave pass-out horizontal engine directly coupled to a 250-V, 350-kW d.c. generator. Steam is supplied to the engine at 185 lb. per sq. in. from a Lancashire boiler, the pass-out steam for process in the mill being at 20 lb. per sq. in. Kent recording flow-meters measure, respectively, the engine feed and exhaust steam. There is also a 100-h.p. Gilbert Gilkes water turbine which can be operated in conjunction with or independently of the main supply. A friction clutch on the main shaft enables it to be coupled directly to either the wet process part of the mill or to a 160-h.p. reversible generator.

Through a change-over contactor starting panel this machine can be connected to the main supply and run as a motor to drive that part of the mill which would otherwise be driven by the water turbine, and also run as a generator either independently of or in parallel with the main supply, the electrical connections being taken through the appropriate panels of an open type flat-back switchboard. The motor can be left more or less permanently in parallel with the 350-kW generator, its function, either as a motor or generator, being determined by a shunt regulator.

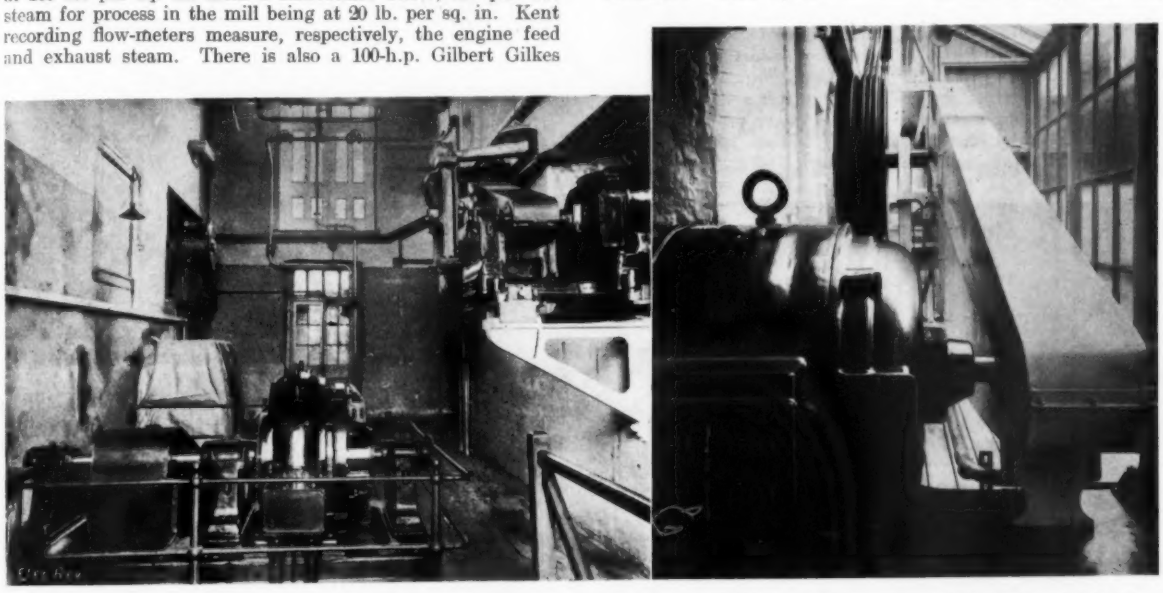
The motors vary in size from ¼ h.p. to 160 h.p. All the water used for both steam generation and mill process is obtained from an artesian well on site, 198 ft. deep and 12 in. bore, equipped with a Mather & Platt centrifugal pump driven by a 12-h.p. motor. The well and its equipment are capable of delivering 12,000 gallons of water per hour. The water needs no treatment whatever, either for the mill or the boiler. The pumping set is automatically controlled by a simple float switch.

Derby Street Mill is engaged primarily on the production of woollen felts for paper mills and laundries. The driving power is provided by a side-by-side Musgrave Corliss condensing engine which transmits its power partly by ropes to some of the machinery drives direct, and partly in the same way to a 350-kW generator. This engine has been recently fitted with larger cylinders by Messrs. Hick, Hargreaves & Co., Ltd., thereby increasing its output from 800 to 1,000 h.p. Two Lancashire boilers supply the steam at 160 lb. per sq. in. For pilot lighting when the main set is not working there is a 60-kW Belliss & Morcom steam generating set which can also be run in parallel with the main generator on to an open type flat-back switchboard.

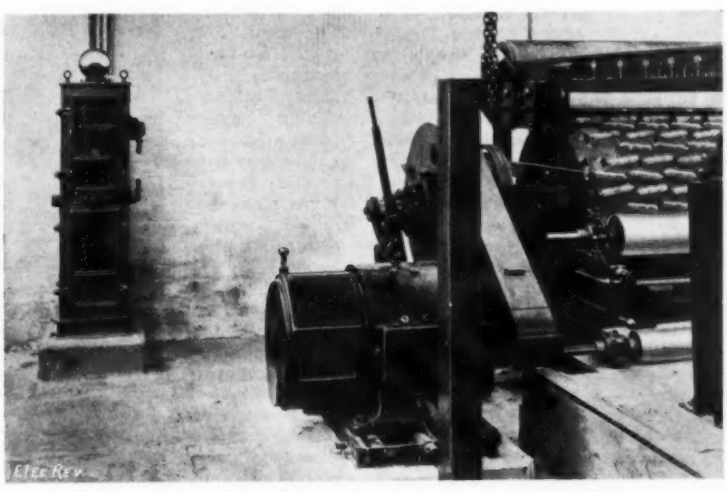
Practically all the motors we saw are of Messrs. Mather & Platt's manufacture, and they are all operated by Brookhirst contactor-type starting panels with push-button control. In some cases, such as, for example, the equipment for hydro extractors which operate in very humid atmospheres, the starter panels are remotely situated from the actual machines near which are located the push buttons. For driving such equipment as drying cylinders, tentering machines, warping barrels and some of the looms variable-speed motors are employed, the speed being hand regulated in each case by a rheostat incorporated in the starting panel. At Derby Street all the motors are controlled from the switchroom where there is a multiple push-button board, but near each motor-starting panel there is a three-button panel with one button for each of the starting, stopping and inching operations. The inching and starting buttons are locked to prevent unauthorised use.

All the immediate motor drives are *via* enclosed Renold chains fitted with pump lubrication. One drive at Derby Street is of particular interest in that it employs an unusually long chain (18 ft. double) from the motor to a common shaft. This shaft provides the group drive for machinery in the room on the same level. Rope drives are also taken from this shaft to others above and below, with the result that the main chain and rope driving serves three flats, the motor and pulleys, &c., being located outside the normal exterior wall of the building and protected by a wood and glass enclosure.

The generators at all the mills visited, including the reversible generator at Crimble, were manufactured by Mather & Platt, Ltd., the special change-over contactor panels by Brookhirst Switchgear, Ltd., and all the distribution switchboards referred to by Messrs. Whipp & Bourne, Ltd.



Left: Reversible generator and two 50-h.p. motors driving carding and willow machinery at Crimble Mill. Right: A three-flat 75-h.p. motor drive embodying an 18-ft. chain drive



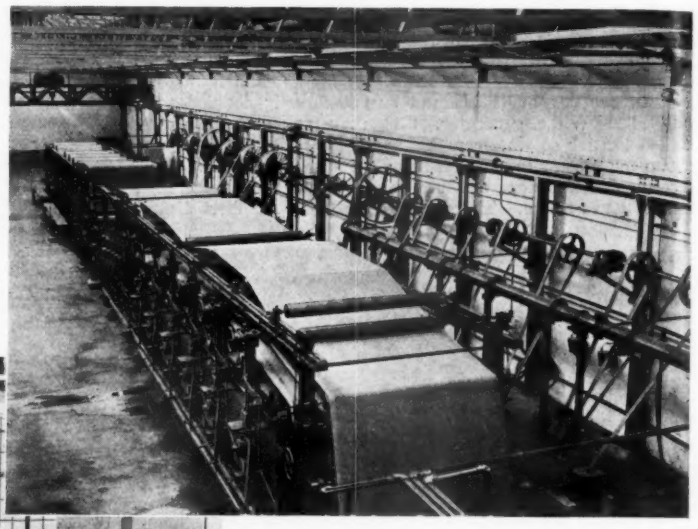
A 20-h.p. drip-proof motor chain driving a raising machine

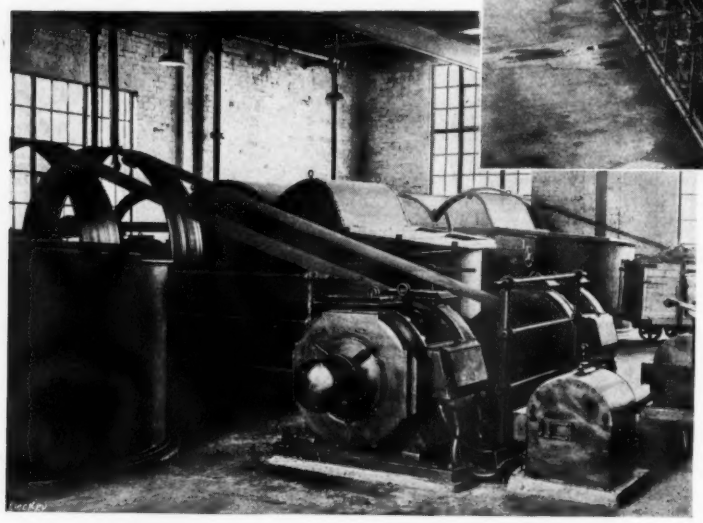
Insulating Pressboard Factory Driving

A scheme for using stand-by plant on normal load

WHEN the Wharfedale (Yorkshire) factory of Messrs. B. S. & W. Whiteley, Ltd., which is now devoted mainly to the production of " Elephantide " insulating pressboard, was taken over as a pressboard factory in 1886 by the present owners, the power plant consisted of two old-fashioned under-shot water wheels and a very old horizontal steam engine. During the early part of the war this was augmented by two 65-h.p. suction gas engines, and in 1919 two 100-h.p. vertical water turbines were installed.

These turbines are in full operation to-day, and are coupled together on a common shaft and belted on to a main mill shaft. They also provide the drive for a 60-kW 460-V d.c. generator (which, incidentally, produced the first electric power used in the factory) for motors driving machinery previously served by one of the water wheels; all this original plant is still in operation.





Left: Individual 100-h.p. drives for beaters. Right: The continuous board machine, driven by a variable speed a.c. commutator motor

In 1924, as part of a general works extension, a modern 385-h.p. Uniflo steam engine was installed, steam being required for process work, as well as a 165-kW generator and various motor-driven equipment. By means of a single shaft the engine drove six beaters and the generator. About this time the first contract with the Yorkshire Electric Power Co. was signed for a stand-by supply of 25 kW. From this small beginning the power load has increased to such an extent that it now requires two fair-sized sub-stations rated at 800 kVA and 500 kVA respectively.

In 1928 further extensions necessitated shutting down the steam engine and electrifying the whole of the factory, and an a.c.-d.c. motor-generator was installed to serve the d.c. equipment previously supplied by the engine-driven generator. A 200-h.p. a.c. 400-V motor was also installed as a stand-by to the turbine plant, a chain drive and friction clutch enabling it to be started up whilst the turbine plant was still in action, and the speed to be maintained on the main mill line shaft.

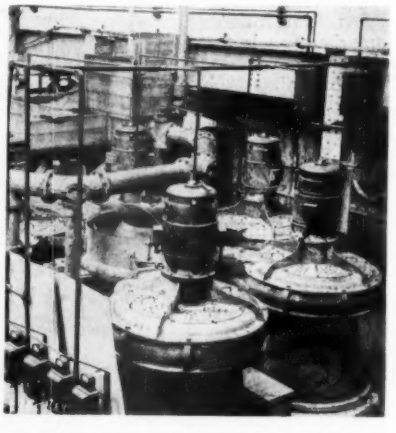
The corresponding section of the mill can be driven either from the a.c. motor only or from the water power only, or from a combination of both which enables full production to be maintained in all circumstances—a very striking illustration of the advantage of stand-by plant supplied from a power company's mains. The electrical plant throughout the mill is that usually met with in paper and board mills, one interesting item being the commutator motor for the continuous board machine. This has a speed range of four to one, and push-button control at various points, the brush gear being motor driven.

The largest single a.c. motor in the factory, apart from the motor-generator set, is a 230-h.p. unit driving a battery of beaters, while there are five 100-h.p. motors driving beaters in other parts of the factory. A two-ton lift serves the three floors of the building, and a transporter hoist lifts the raw materials (mainly textile) to the top storey. The materials are chopped by a motor-driven rag chopper, and to ensure that ' Elephantide " is free from any metallic particles the materials are dealt with in motor-driven centrifugal separators.

The calenders for the sheets and reel material are driven by 60-h.p. motors, while all other machines for such operations as reeling, cross-cutting and narrow web slitting are individually motor driven. The factory is equipped with three 5-ton Royce three-motor cranes, and one crane is being arranged to serve the new 150-ft. extension to one bay.

Electrically heated ovens, with thermostatic control, and with varying loadings from 10 to 40 kW, are employed for drying out the " Elephantide " products. On the board-drying machines there are motor-driven fans with loadings of from 2 kW to 30 kW, while there are several examples of motor-driven extraction fans in the factory. Individual sheets are tested for accuracy in thickness on electrical apparatus developed by the company's engineer, and there are three electrically driven trucks for transporting goods throughout the works.

To ensure that the fire hazard is reduced to the minimum, the factory is built in three separate units, two of which operate night and day. The latest unit is at present sufficient in size to deal with the sales on day load only, leaving a useful margin for further development.



A battery of motor-driven centrifugal separators

To obtain maximum reliability is the main reason given for the change-over from private generating plant to public supply, alternative mains being laid into the sub-stations to ensure continuity of supply in the event of a mains failure. From the power company's point of view, the load is an admirable one, for all the heavy machinery is operated over the full twenty-four hours. Approximately 120 electric motors are in operation for the best part of the day, their total capacity being in the neighbourhood of 2,500 h.p.

The multi-ply press-paper processes employed in the early stages of the manufacture of " Elephantide " are very similar to those employed in producing ordinary high-grade pressboards. But after the fibres have been dehydrated sufficiently for converting the board into sheet, pulp is dealt with on the special press-paper-making machine. There are several different grades of the insulating material.

Water-heater Maintenance. By P. C. Honey

Faults and their rectification

IN the past undertakings which were pioneers in water heating had to buy their experience, sometimes at considerable cost, and the experience of other vendors of heat was of use only as regarded the hydraulic aspect. To-day the manufacturers have made maintenance an easy matter. Generally speaking, the harder the water the heavier the maintenance entailed, but scaling is not so serious as with solid fuel or gas.

The maintenance of electric water heaters, hired or hire-purchased, nominally finishes at the heater itself, unless otherwise agreed. Maintenance of external fittings not within the scope of the agreement provides an opportunity of increasing the goodwill of the undertaking if it does not cost much and does not antagonise local private enterprise, but there is a danger of a claim for consequential damage arising from a small repair carried out as a small service. Thus a ball valve may be adjusted correctly, but if the ball later becomes detached, due to fair wear and tear, and the overflow pipe is choked the undertaking may be held liable by the consumer for damage to decorations due to the water overflowing.

Faults in electric water heaters and immersion heaters fall into four sections (1) electrical, (2) hydraulic, (3) heater material, and (4) fixing. The heating element is the least likely to give trouble. The loading per sq. in. of heating surface is nowadays so small that scale does not tend to produce hotspots, and doubling the element at its connections should prevent its burning off at the terminals. Faults to earth are rare with immersion heaters; mica-insulated elements are more prone to these than the air-spaced or cement-filled types.

Thermostats can give trouble due to sticking "on" or "off" and irregular action. The first trouble draws attention to itself by the steam and noise produced; the second is not discovered for some hours after. In mercury thermostats, a cracked tube will cause either or both of these faults. Air leaks into the tube through the crack and oxidises the mercury just where the circuit is broken, every succeeding arc making matters worse. The oxide deposit is sufficient to hold the mercury across the contacts, even when the tube is tilted well above the usual angle, keeping the current "on" long after it should have been "off." Similarly the oxide deposit will hold the mercury away from the contacts when the tube has been depressed due to the cold water. Irregular action can best be proved by connecting a recording ammeter in circuit with the element. If the thermostat rod becomes covered with scale the action becomes sluggish and the temperature alternates between too high and too low a value.

Internal connections give little trouble beyond occasional failures of insulation. Fish spine insulators on thermostat connections should not touch the adjoining casing or metal. Not only may this obstruct the working of the thermostat, but if water collects on the bottom of the plate cover (due to slight leakage or condensation from the lagging) considerable interference with radio can result; loose connections have the same effect.

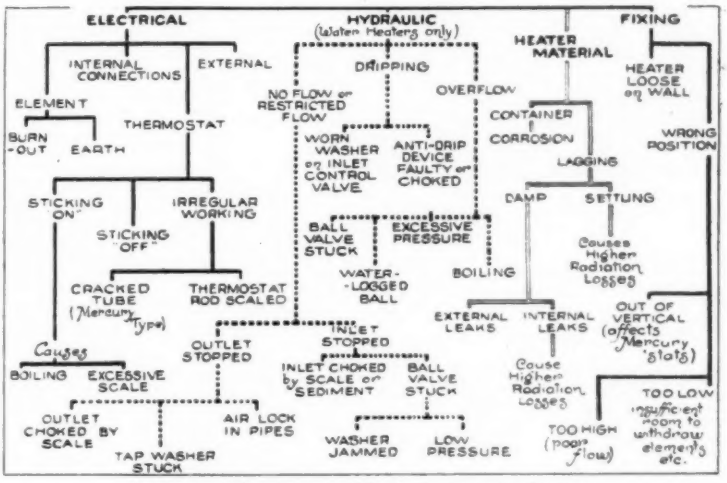
Hydraulic Faults

The majority of hydraulic faults will be found with the open outlet (or displacement) and the cistern types of heater. Hard water districts are especially subject to complaints of "no flow" or "poor flow." Small sink heaters are the worst offenders as they hold water at high temperature for most of their working life. Scale collects in and around the top of the outlet and eventually almost chokes it. The inlet, too, may, but less frequently, become choked with scale and sediment. Stoppage or poor flow with a cistern heater is almost invariably traceable to the ball-valve washer which, where the water pressure is low, often remains on its seating, held by resistance to movement due to the configuration of the washer which has become embedded in the valve seating. A new washer will remedy this defect temporarily, but a valve designed for low pressures is better.

Owing to the low head of water often found at the taps fed by cistern heaters, stoppage of water at any one point can often be traced to a similar fault in the tap itself. The use of a proper hot-water tap, with its jumper attached and rising with the tap spindle, would prevent this.

Air lock is often the result of the position of the heater, especially if the head of water is poor. It is more prevalent with semi-pressure heaters working in conjunction with fuel-fired boilers. The plumber's old dodge of flushing the whole system with water at mains pressure will cure the fault, but a permanent cure can be achieved only by refixing the heater at a lower level or by the doubtful expedient of inserting a non-return valve just below water level in the offending expansion pipe. The overflow pipe should always be terminated where waste will be noticed. This pipe is often the only place where steam generated by the heater when boiling can be seen, and it should never be led into waste pipes.

Owing to the limited space in which the ball valve in a cistern heater operates, the leverage to keep the valve on its seat is often insufficient, especially where pressures are high,



A diagram showing possible faults in water heaters

but the provision of a large dished ball overcomes this fault. If the ball has become waterlogged it will fail to close the valve; this may be due to its soldered seams being below water level. Overflow from a semi-pressure heater or an immersion heater may be due to steam from boiling being prevented from escaping, thus causing the water to back up the inlet pipe into the cold tank.

Really satisfactory anti-drip devices are rare, the simplest type not permitting the drawing off of small quantities of water without waste. The continued drip of water annoys the consumer but unless it be due to wear of the inlet control valve allowing water to leak into the heater the only remedy is to see that the anti-drip device is not choked with scale; sometimes the refitting of the spout with fresh packing will effect a cure. In some types the cap on the top outlet must be airtight for proper working.

Leakage Repairs

Internal and external leaks in the water heater itself are serious faults, but they are fortunately rare nowadays as the modern heater is much more robust in this respect. External leaks usually occur in the water heater connections, thermostat rod, element sheath, or at the junction of the apparatus plate and the heater container. Repair does not necessarily entail dismantling the installation.

Internal leaks occurring between inner and outer container are likewise uncommon in modern heaters: they are hard to locate and generally raise radiation losses. To effect repair the whole heater must be removed to the maintenance department's shops.

The cork lagging must be perfectly dry; if damp it loses its heat-insulating properties. With immersion heaters the cork settles after a time, leaving spaces on the top which require filling to avoid slightly increased radiation losses. The few troubles experienced with the inner and outer containers are, apart from leaks, usually due to corrosion. The tinning of copper interiors and galvanising of sheet-steel exteriors are designed to overcome this possibility.

Faults in fixing cause a great deal of unnecessary work and as a general rule are unpardonable. With the security obtainable with modern methods water heaters fixed to a wall should never come adrift. When calibrated mercury thermostats are used non-vertical fixing affects the temperature of cutting out. The heater can be fitted too high in relation to the cold water tank, resulting in poor flow and airlock, or so low that there is insufficient room for withdrawing the element or thermostat rod.

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Improvements in Cooker Design. By V. H. Vale

AS the construction of cookers, whether electric or not, varies considerably with the country of origin they can be discussed under the following headings: (1) American and Canadian; (2) Continental; (3) British.

[*Fox Photos.*
Mr. V. H. Vale is with the General Electric Co., Ltd

The greatest progress is evident in America, which can justifiably claim to be the pioneer in systematic kitchen planning. Definite strides have been made during the last two years not only in the construction of individual stoves but in the modification of designs to permit the cooker to become an integral part of the kitchen equipment rather than an independent unit. The present trend is for the cooker to be combined with the refrigerator, sink and "work surface" to form a complete all-electric kitchenette.

The advantages of this arrangement are that steps are saved; the fullest possible use is made of available space; and cleaning of the kitchen is simplified, for all the essential equipment is compact. This combined equipment is reported to have a very strong selling power and so appeals to builders and architects of

An all-electric "kitchenette"

small flats and apartment houses. A likely criticism is that for reasons of safety it is, perhaps, unwise to encourage an installation in which an electric cooker is in such close proximity to the water supply and sink. A foretaste of this arrangement has recently appeared on the British market in the form of a combined cooker and refrigerator.

The table or buffet type of cooker, in which the oven is at eye level and with the hot plate at the side, has always been popular. Stooping is obviated, but the cooker occupies approximately twice as much floor space as one in which the oven is situated below the boiling plate. Gradually the legs of the cooker have become shorter, a warming chamber being housed below the horizontally placed switches, and the difference in level between the top of the oven and hob has been halved.

The next step in the development brought the top of the oven level with the hob, thus providing a table top alongside the boiling elements. This cooker can best be described as a compact cabinet, reaching to floor level with unbroken lines, eliminating all dust collecting ledges and enabling the cooker to be built in. No grill of the English type is provided on this, the most modern of cookers, but a warming drawer and two utility drawers form an integral part. Some manufacturers have added such features as a toaster, and some a so-called "fireless-cooker well" which really is an insulated container sunk in the top of the hob, provided with a low-temperature heating element.

Open-coil boiling plates are still offered by the leading manufacturers and some now supply broilers of types which tend to minimise smoking during cooking. In these the fat is conducted into a container away from the heat zone. Thermostatic control of oven temperatures is universal on all but the cheapest American ranges, and a device which enables the housewife to set a clock so that the current may be switched on and off at any predetermined time is to be found in homes which can afford it.

The standard finish is porcelain enamel in plain colours, white, grey, cream and green being popular. Monel metal tops are fitted as an extra on the higher priced ranges. Mottled grey finish apparently makes no appeal to the American housewife.

An unorthodox design

Canadian cookers resemble American very closely, but one of the best known Canadian ranges, which is now manufactured in England, is provided with a pressed-steel top for covering the boiling plates when not in use. Before boiling or frying is commenced the "lid" is lifted and forms a most efficient splash guard.

Continental Ideas

Electric cooking is undoubtedly advancing on the Continent. Standardisation is far ahead of either American or British practice and there has been practically no modification in the accepted style which includes an oven, deep from back to front, fitted with a drop door and provided with the minimum of three totally enclosed hot plates of standard diameters, 22, 18 and 14.5 cm. These cookers are not provided with thermostatic heat control or thermometers as no demand for them exists.

An outstanding feature is interchangeability of boiling plates between different makes. This is made possible by the mounting of a standard four-point plug on the back of every hot plate and by a corresponding standardisation of the sockets and boiling-plate mounting. All boiling plates are of the totally enclosed type and in some countries open-coil plates are definitely forbidden. Many cookers can be connected directly between phases; thus boiling plates, switches and oven elements work directly on 380 V.

In Germany combined coal and electric ranges are popular, but where a more economical outfit is demanded, a small tubular oven with grill is used in conjunction with a double quick-boiling plate mounted on a porcelain enamel stand. The accepted finish of Continental cookers whether gas, coal

Left: The improved heat-storage cooker. Right: A Continental pedestal cooker with standard four-pin plug arrangement

or electric is white, grey or cream, with black hob and chromium-plated fittings.

British Designs

There has been nothing revolutionary in the electric cooking developments in Great Britain during the last two years with the possible exception of the heat-storage cooker. With the coming of so many new electrical appliance manufacturers, it is highly probable that some marked changes will manifest themselves in the near future. There are, however, several small improvements and modifications deserving of mention.

All-enamel "de luxe" finish in mottled grey porcelain of various tones and graduations is now the standard, but there is little doubt that electric cooker manufacturers will shortly be persuaded to offer a coloured finish at no extra charge. The optional fittings which have for too long filled our catalogues are now included in the general equipment, usually at no increased cost to the purchaser.

The British housewife accustomed as she is to the widespread publicity afforded to the thermostatically controlled gas oven, will probably expect a thermostat to be included as standard equipment on electric cookers. When this comes it will not be as a necessity but as fashion's demand. Whether supply engineers will be willing to pay for this extra refinement is a matter for conjecture.

Grill-boiler units have regained popular favour and, while the insistent demand for low-priced cookers continues, this feature will doubtless remain, although a separate grill and boiling plate are more efficient. Warming cupboards are now one-piece welded units: latterly there has been a tendency to increase their capacity which has resulted in the discarding of the plate rack and splash guard, a low type of guard, which affords adequate protection to the wall, having replaced the older type.

Side and bottom heating of the oven is still favoured by the majority of manufacturers. The position of the oven elements can be grouped as follows:—

(1) A one-piece removable oven interior surrounded with elements fixed by screwed connections to the busbars; (2) a plug-in element fitted directly in the net cooking space; or (3) a fixed oven interior with the elements fitted on the outside and withdrawable from the back. The housewife favours the removable interior, owing to the ease of cleaning.

The totally enclosed embedded boiling plate is most commonly used throughout the world—on the Continent other types are seldom seen. In America it shares popularity with the radiant type, whilst in this country, although manufacturers are not restricted in any way regarding the style of hot plates which they provide on their cookers, there is a much greater demand for the enclosed type. In the near future we shall see a totally enclosed boiling plate, loaded at 2,250 W for the 8-in. diameter size, which will give still quicker boiling times without any increase in wire temperature, and consequently with as long a life as the present models.

A modern American cooker

The Heat Storage Cooker

The heat-storage cooker, which was first marketed about two years ago, consists, in principle, of a block of iron (insulated on all sides from heat losses) which acts as a medium for storing heat. The input, provided by immersion-type heaters of low loading—500 W in the original model—is constant, the output being varied from hour to hour by the amount of cooking done.

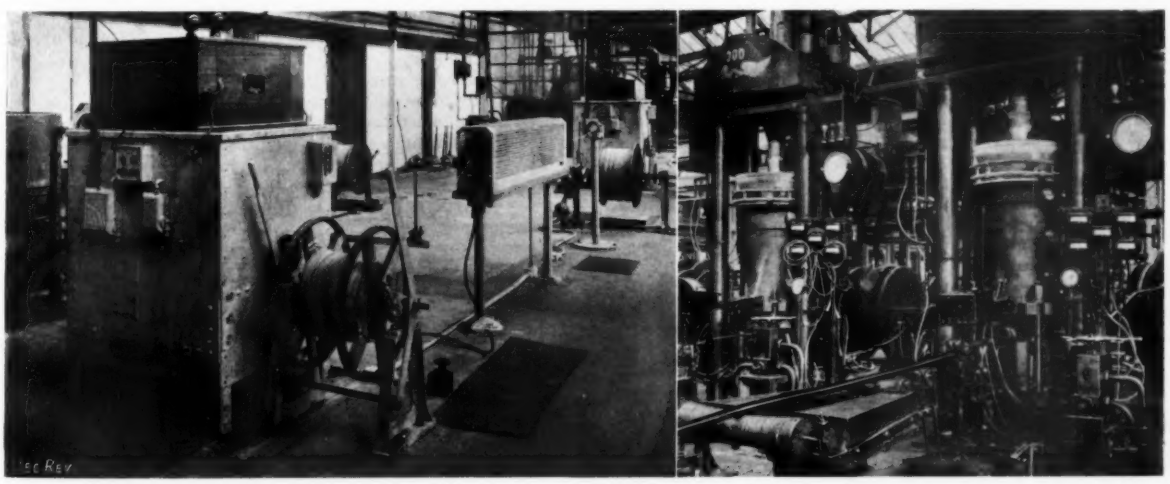
Two pints of water can be boiled from cold in four minutes. The oven is evenly heated on all sides and is always ready for casserole and other low-temperature cooking, while the additional temperature required for roasting or baking can be quickly obtained by operating a switch.

Progress in the Cable Industry. By C. J. Beaver, M.I.E.E.

IN my opinion the cable-making industry may justifiably claim to have utilised the period of depression from which we are slowly emerging in attaining a greater rate of development than heretofore in nearly every direction. In some directions these developments are overdue, but in the past many things now coming to fruition were "born out of due time" and had to await the convergence of various other factors.

In last year's I.M.E.A. Convention Number of this journal, I referred to the crystallised form of some of the general developments represented by the revised British Standard Specification which had just been issued. The reception of this Specification by the electrical industry in general has been of a somewhat mixed character, and many large users have chosen to adhere to the more robust Standard Specification No. 7. Though this attitude may include a tinge of conservatism, it would appear in most cases to arise chiefly from a sound appreciation of mechanical requirements and of the indeterminate character of the margin of mechanical safety in installation practice with regard to the degree of encroachment upon it by reductions in dimensions.

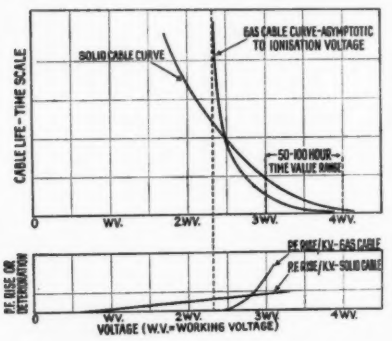
For many years the practice of some users has been to employ higher voltage cables—*e.g.*, 3,300-V cables for 2,200-V working—in order to provide the mechanical margin necessary for onerous conditions of installation, such as occur in mining work. Even municipal engineers followed this practice in some cases, and many of them still hold strongly that a substantial margin of mechanical safety is well worth paying for. Rural electrification by underground cables has proceeded apace during the past year or two, and is fast approaching a sound competitive basis in relation to overhead lines, partly due to improvements in cable technique and partly to a con-



Left: "Spark-test" equipment. Right: The new lead press described in the article

siderable advance in installation machinery, developed for cross-country and rural road excavation and reinstatement.

In details of cable production, in addition to steady progress in the improvement of insulating plant and processes, perhaps the most remarkable advances have been in connection with lead and lead-alloy sheathing operations. The metal sheathing process in cable manufacture is by no means the simple matter that inspection of it in operation might lead one to assume, and the care of its details has always provided scope for simplification and "fool-proofing." The past year has seen the commercial introduction of a patented process—with the development of which I have been associated—which produces lead and lead-alloy tubes which may be continuously sampled foot by foot and mechanically expanded to, say, two and a half times the original diameter without showing incipient weakness.



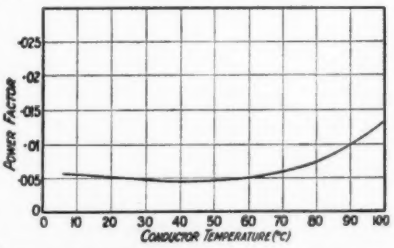
The time/breakdown-voltage curves of gas-filled and solid cables

The principle of this improved lead sheathing process is the sealing of the lead press container by a reservoir of the molten metal, so that oxidation between charges is prevented, and the complete union of the succeeding with the preceding charge is ensured. The feeding of the molten metal to the reservoir, and subsequently to the container, is entirely automatic. An incidental but important effect—beneficial to the cable—which is attained by this arrangement is the very considerable reduction of time during which the cable is exposed to the heat of the press. Other even more remarkable developments in metal sheathing technique are in the offing.

Regarding insulating materials, perhaps the most remarkable addition is "sulphurless" vulcanised rubber, on which considerable development work has been done during the past year or so. Such rubber is not only a sound chemical proposition in skilled hands, but is also capable of giving very appreciable technical improvements in rubber-insulated cables.

A New Method of Testing Rubber Insulation

A method of testing rubber-insulated wires and cables, emanating from and widely used in America, has been closely investigated by myself and my associates during the past two years in relation to British conditions and requirements. The method, known as "spark testing," consists in passing the insulated wire after vulcanisation through a tube in which a relatively high voltage is maintained between the conductor and the whole exterior surface of the insulation. The voltage is chosen in relation to the thickness of dielectric (*e.g.*, 6,000 V for 1/0.004 in. or 40/36–34 to 38 mils radial; 8,000 V for 7/0.044 in., and so on) so that a spark, intense enough to burn a traceable hole in the dielectric, passes with certainty through any part of the insulation which may contain an incipient defect. In such a case, the winding operation is promptly and automatically stopped and the fault located. With this test faults are detectable which an immersion test would not reveal.



Power-factor/temperature curve for a gas-filled cable

It affords no actual measurement of insulation resistance, however. This is fundamentally a check on uniformity of material, and as the insulating process is a mass production job in which not fewer than twenty-four wires are insulated in parallel, this checking can be effectively done by subjecting, say, 10 per cent. of a batch of wires to the insulation-resistance test in water. I venture to prophesy that the time is not far distant when this "spark test" will entirely displace the 24-hour immersion test, and that it will be specified by all Government Departments and other large users.

The Gas-filled Cable

Development work on the gas-filled cable has made rapid strides since the initial demonstrations which I described a year ago in this journal. These related to long periods of heavy daily loading cycles at high electrical stresses carried out on factory lengths, laid and jointed.

During the past year the remarkable results have been confirmed by further continuous running, under various greatly exaggerated conditions, to demonstrate that ample margins of safety exist in the cable and in its straight-through joints and terminal ends. For example, although in a good commercial design, ensuring complete absence of ionisation up to twice working voltage, gas pressures of 150 to 200 lb. per sq. in. need not be exceeded, a laid cable complete with its porcelain sealing ends, gas-filled to an internal pressure of 350 lb. per sq. in., has been running satisfactorily for several months under daily load cycle and voltage conditions. Again, temperature conditions have been exaggerated in another cable which is loaded daily to 100 deg. C., under the usual continually applied voltage conditions, *i.e.*, 10 per cent. above working pressure.

[*Lafayette*

Mr. C. J. Beaver is a director of Messrs. W. T. Glover & Co., Ltd.

Time-voltage breakdown tests have shown that stresses up to a value predetermined in the design of the cable, *i.e.*, dependent on the dimensions of and pressure in the gas space, can be supported for thousands of hours, breakdown being then attained by slightly raising the voltage or lowering the gas pressure, showing that the time-breakdown-voltage curve is asymptotic to the designed ionisation voltage. The difference between this and the indefinite curve of the solid type cable is due to the existence of some ionisation in the latter and absence of it in the former until the predesigned value of ionisation voltage is reached.

In view of the physical character of the gas-filled dielectric as a whole it is important to note that the thermal resistivity of the gas-filled cable is rather less than 600 thermal ohms per cm³, which compares favourably with the value of 550 for a solid-type h.v. cable. Converting this into terms of current rating, the value for the gas-filled cable is only about 1 per cent. below the solid type, comparing either three single cores or a screened three-core cable laid direct in the ground.

Impulse-voltage tests at several times the peak working voltage have shown no change of power factor after repeated surges, indicating the absence of susceptibility to breakdown of the gas spaces under surge conditions. At various stages, these experimental cables have been sampled and dissected and have been found perfectly free from signs of ionisation effects.

A variation—and recognition—of the principle of gas filling has been recently brought to public notice in the guise of the "gas-cushion" cable, which makes appreciable use of the physical advantages, and—more remotely—of the electrical features of the "gas-filled" cable.

High-grade Steel Production (*continued from opposite page*)

value set by load adjustment resistances shunted across the regulator control coils. The automatic gear can be substituted at will by clutches for hand operation. All the furnaces are tilted electrically. Each three-ton charge is melted in about 4½ hours, and the maximum load per furnace is about 900 kVA. The consumption, which varies according to the quality of the steel, probably averages around 850 kWh per ton. The ingot-producing and foundry furnaces are identical in all respects.

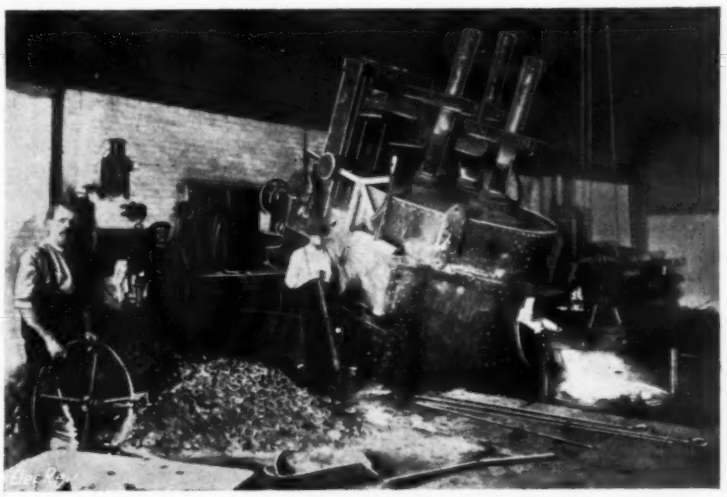
In the heat-treatment department we saw a Wild-Barfield vertical cylindrical furnace with forced air circulation used for tempering high-speed steels. This is equipped with thermo-couples at the top and bottom of the chamber (entry and exit points of the air), and similar temperature indications from both couples denote that the charge is heated uniformly. A Venner time switch in circuit renders it possible to control furnace operations during non-working hours. A wire-wound vertical furnace controlled by Cambridge equipment maintains any desired temperature, and in the research department there are two similar equipments, but arranged horizontally and equipped with automatic control. The last three furnaces were produced by Messrs. Samuel Osborn's engineering and metallurgical departments.

High-grade Steel Production

An important Sheffield works

THE most interesting thing we learnt at the high-grade steel works, Sheffield, of Messrs. Samuel Osborn & Co., Ltd., was that the high-frequency furnace is not essentially an equipment for the production of a higher grade of steel than that which can be manufactured in the electrode arc furnace, but is employed for reasons of economy and ease of working. There is, we believe, a more definite control of the analysis of the charge and certain types of rustless steels which necessitate a very low carbon content can be dealt with more consistently. Further, we were told that the high-frequency furnace generally affords a consumption saving of 100 kWh per ton as compared with an electrode furnace.

At these works there are at present a ½-ton high-frequency furnace which, with its auxiliary equipment, was supplied by the Metropolitan-Vickers Electrical Co., Ltd., and three Heroult electrode arc furnaces employed for actually melting steel and two similar furnaces supplied for the production of steel castings in the foundry, which were supplied and installed by the Electric Furnace Co., Ltd. The high-frequency furnace body has a skeleton framework of gunmetal on which the refractory housing is assembled, and the whole is arranged with its tilting mechanism below the platform level to avoid obstructions. There are compensating balance weights to facilitate easy tilting, and the tilting is governed by limit switches.



A three-ton Heroult arc furnace, during pouring

The high-frequency induction coil is arranged outside the lining which has to be renewed periodically. When relining, the basic or acid refractory is built up around a steel cylinder. This temporary steel liner melts with the first charge, holding the refractory in position until the lining proper "sinters" or sets ready for receiving further charges. Acid (silica) lining has an acid reaction with slag products, and so can be used only with acid slag-making material, whereas basic lining, of which the main constituent is natural magnesite, has a basic reaction and can therefore only be used with basic slags, composed mainly of lime.

Basic lining affords an opportunity of refining, *i.e.*, removing phosphorus and sulphur, while the acid-lined furnace is generally used for the production of the highest quality tool steels from very pure materials. There are duplicate furnace bodies supplied from one equipment and controlled by change-over switchgear—an arrangement which permits the renewal of one lining body while the other is working. It takes about an hour to melt one charge of metal, and the average consumption is about 630 kWh per ton, excluding losses which bring the overall figure up to 700 kWh. The furnace is supplied with high-frequency current at 2,200 cycles, 1,500 V, by a single-phase homopolar generator, which is driven at 2,940 r.p.m. by a three-phase 50-cycle s.c. motor.

The supply is controlled by contactor equipment operated from the control board on the platform. As the furnace power factor averages only 0.1, a bank of condensers in parallel with the furnace provides correction, with the result that in the furnace coil the current is about ten times that in the generator coils. The six sections of the condensers are arranged so that they can be brought into circuit progressively as the melt proceeds by a selector switch governing the contactors. The generator voltage can be varied by a field rheostat to suit the rate of heating, the rate of temperature rise being proportional to the furnace input. A push switch on the platform control board operates the main generator contactor, and there are separate controls for the auxiliaries.

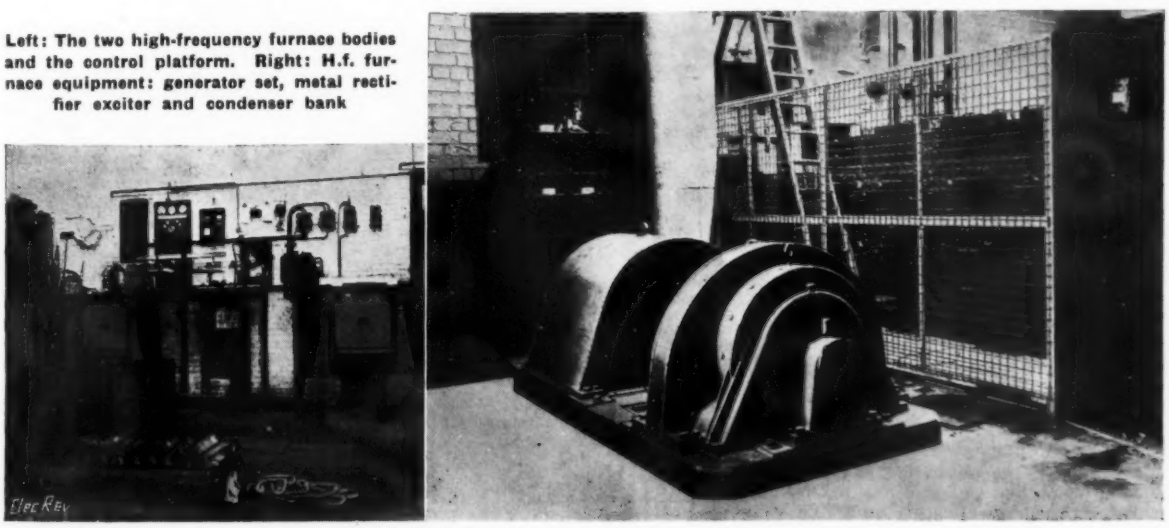
The furnace coils are water-cooled and there is a water relay interlocked with the main generator contactor. The excitation current required for the generator is very small, and a Westinghouse metal rectifier is employed. The condensers were supplied by British Insulated Cables, Ltd. A half-ton high-frequency furnace of the same manufacture is soon to be installed.

The Electrode Furnaces

The arc furnaces are employed generally more for the production of constructional steels, and they produce ingots of up to about 53 cwt. They are all supplied at 11,000 V, each having its own bank of transformers, which reduces the pressure direct to that required for melting, 83 V at the start and early stages of melting, and 74 V at the finish. These working pressures are varied and controlled by selector switches on the primary sides of the transformers. Each transformer bank has three separate single-phase limbs, and there is a control board to each furnace equipped with indicating and integrating input kilowatt meters and ammeters, voltmeters and pilot lamps.

The arcs are automatically controlled by regulators which operate motors and will adjust the load to any predetermined

(*Continued on the opposite page.*)



Left: The two high-frequency furnace bodies and the control platform. Right: H.f. furnace equipment: generator set, metal rectifier exciter and condenser bank

Electric Furnaces. By E. Morgan, M.I.E.E., A.M.Inst.C.E.

Their growing use in steelworks

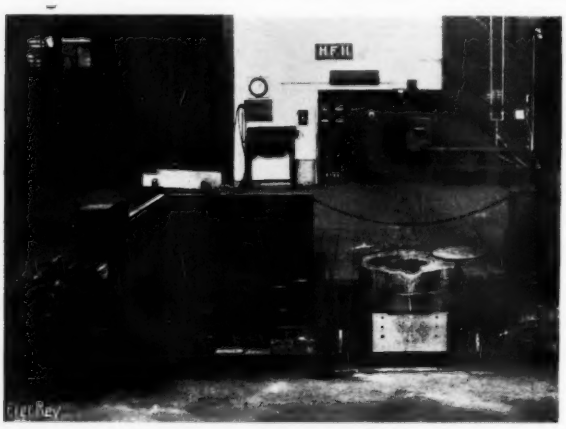
RAPID strides in the production of steel by electricity have taken place during the last twenty years; during the last five years remarkable progress has been made in Sheffield in the use of all types of electric furnaces and for certain qualities of steel electric melting is standard.

There are two main types of furnace in use for smelting—arc and high-frequency—and very large numbers of both types are in everyday use. A great majority are at present supplied with electricity from the Corporation mains and many more will be connected in the course of the next few months.

Electric heating has certain obvious advantages such as are readily appreciated by users of electricity in general. There are less obvious advantages, both physically and chemically, and the electric furnace owes its vogue not to cheapness but to the general convenience and special methods of manipulation made possible by its means.

Arc furnaces hold the field for the production of steel on a large scale; they range in capacity from about half a ton to twenty-five tons. They enable steel to be produced much more cheaply than crucible steel—approximately a third cheaper in the final ingot; they also lend themselves to the manufacture of high-grade and special steels which could not be attempted with solid-fuel methods.

Whilst the majority of arc furnaces employ a basic hearth, acid linings are sometimes used consisting mainly of silica. The nature of the lining influences the furnace process, and



A one-ton high-frequency furnace

whilst in the open-hearth furnace the better quality steels are usually made on an acid lining owing to the better deoxidation conditions obtainable, the electric arc furnace lends itself to ready changing of the type of slag used on the steel hearth. For this reason a basic hearth can be used to advantage, since it facilitates removal of certain impurities—more particularly phosphorus, during the preliminary oxidation stage, whilst permitting a change over to "reducing" conditions later. In the production of high quality steels, removal of oxygen is most important. The conditions in the arc furnace using carbon electrodes tend, naturally, to be "reducing" since oxygen can be readily taken up by the incandescent carbon. In the reducing stage of the operations of steel making in the arc furnace, a special slag is formed on the surface of the steel and, by having this formed with a lime base, erosive attack on the basic lining is minimised.

Steels having special mechanical properties, such as high tensile steels, those having special physical properties such as magnet steels, and those having special chemical and heat-resisting properties such as the stainless and non-scaling steels are largely the product of the electric furnace, for such qualities are more readily obtainable by this method.

It is due to this process of reducing that practically all low carbon steels with 7 per cent. to 14 per cent. of chromium are made in electric furnaces, using common steel scrap, turnings, &c. Another important advantage of the electric furnace is the flexibility with regard to temperature. The temperature can be raised when necessary, and with little delay, for the purpose of accelerating the desired chemical changes or for bringing the steel to the desired temperature for pouring.

The energy used by an arc furnace per ton of steel depends on the condition of the scrap and the amount of refinement required, the grade of steel required, and the size of the furnace, but a good quality carbon steel made in a 5-ton arc furnace loaded to 1,500 kVA, producing about 25 tons per day from cold scrap, will consume an average of 700 kWh per ton. To this amount must be added the cost of the electrodes, approximately 9s. per ton, and the cost of labour, relining and repairs, &c., bringing the total up to about 60s. per ton with electricity at 0.4d. per kWh.

[*Lafayette*

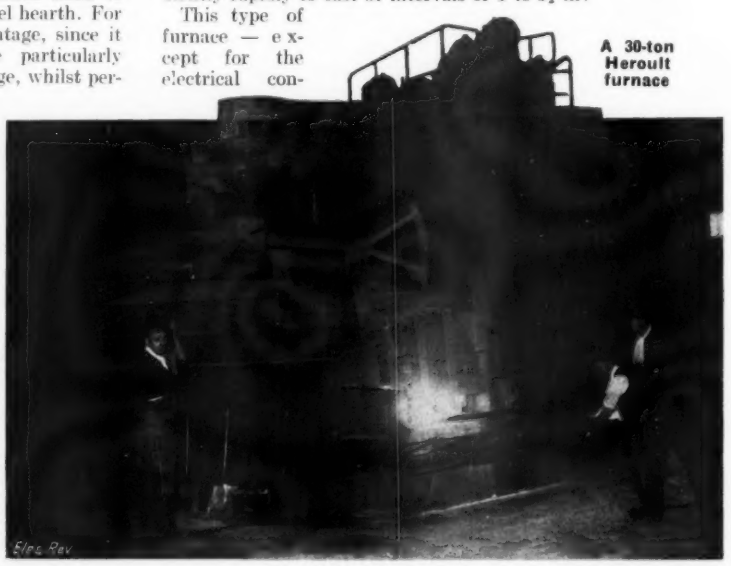
Mr. E. Morgan is general manager of the Sheffield Corporation Electricity Department

The arc furnace is a highly scientific piece of apparatus consisting of various types and arrangements of electrodes and their automatic control, and electrical appliances connected with the operation of the electrodes, charging and discharging, tilting, &c. The steel manufactured includes most of the alloy steels used for aero and automobile purposes, such as nickel steel, nickel-chromium, chromium-vanadium, air-hardening nickel-chromium steels, and chromium-aluminium steels. These furnaces also produce the bulk of the large present-day output of stainless steels, both of the plain chromium and austenitic chromium-nickel types, as well as heat-resisting steels.

High-frequency Furnaces

The high-frequency furnace, which is really an induction furnace, operates in an entirely different manner from the arc furnace, and at frequencies higher than that of the normal a.c. supply. The energy input to the furnace is applied to a water-cooled copper-spiral tube surrounding the furnace space. By induction between the currents in this coil and the metallic charge in the furnace, the heat is generated direct in the charge. No electrodes are required, and it is only necessary to suitably arrange the electricity supply, the coil, and the refractories of the furnace to obtain an efficient and economical method of heating. Furnaces of this type for melting 25 to 30 cwt. of steel are capable of producing special steels sufficiently rapidly to cast at intervals of 1 to 1½ hr.

This type of furnace — except for the electrical connections—resembles a large crucible, but with the advantage of requiring no external fuel. The furnace is adaptable for acid or basic operation, and the furnace atmosphere is capable of ready adjustment. Apart from the greater output, high-frequency melted steel contains no impurities from furnace gases or carbon, and the swirling of the molten steel eliminates



A 30-ton Heroult furnace

those microscopic non-metallic particles which are the starting points of cracks or corrosion.

These furnaces are specially adaptable for the highest grades. The consumption per ton is approximately the same as for an arc furnace up to 10-cwt. capacity, but there are, however, no electrodes to supply and maintain, and the labour involved is very much less. Under running conditions, the cost is about 45s. per ton, but whereas with the arc furnace, scrap steel of almost any quality and size can be fed into the furnace, only that quality of steel which is fed to the high-frequency furnace can be obtained in the resultant melt at the present time. There is, however, one furnace just placed in operation which will carry out that amount of refining with the assistance of slags which can be carried out with the arc furnace.

There are great hopes that the possibilities of the high-frequency furnace carrying out the fullest functions in connection with the production of steel will be rapidly developed, and a great number of the latest type are about to be installed in Sheffield.

The Furnace Load in Sheffield

I have, altogether, connected to my system about 28,000 kW of furnace load, and although there has been very severe depression in Sheffield during these last few years, these furnaces have been installed to enable the highest grade of steels to be manufactured, and in preparation for better times.

Normal figures cannot be given, but Sheffield produced 1,217,000 tons of steel in 1929, 776,600 tons in 1932, and 987,000 tons in 1933. Trade is now on the increase in Sheffield and it is estimated that we are now producing steel at the rate of 1,250,000 tons per annum. In 1933, 55,000 tons of electrically produced steel were manufactured against 39,000 tons in 1932, an increase of 41 per cent. I estimate that 38,500,000 kWh was used for this purpose alone.

In a recent test carried out at a large works, during a period of four weeks, 426 tons of steel was electrically melted with a consumption of 277,750 kWh. The largest consumer that I have at the moment has installed just over 10,000 kW of these furnaces, and uses over six million kWh per annum; there are others with 7,000 kW, 2,000 kW and smaller capacities. As to the future, I have definite orders at the present moment for connecting an additional 22,000 kW of furnace load and there are many inquiries pending due chiefly to the special tariffs for this type of work which we have put into force during these last few years.

Independent of all conditions, we supply electricity for smelting and heat treatment purposes between the hours of 6 a.m. and 6 p.m. at a flat rate of 0.5d. per kWh and between 6 p.m. and 6 a.m. and during the whole week-end at 0.3d. This special tariff has been accepted with open arms in Sheffield, and it works out at less than 0.4d. per kWh.

Other uses of electricity in the steel trade include heat treatment for reheating, tempering, carburising, nitriding, &c. These processes call for more attention than any stage in the manufacture of tools, and every class of tool requires a different degree of hardness. In a recent test in a furnace dealing with the heat treatment of magnets with a capacity of 100 lb. per hour, 22,960 lb. was hardened with a consumption of 0.226 kWh per lb. of metal, but this has recently been reduced to 0.2 kWh per lb.

Two special types of large furnaces, one for hardening and the other for tempering processes, are at present being installed in a works interested in the heat treatment of steel tyres for traction purposes, which will replace gas and oil furnaces of the latest type and will have a capacity of 260 kW each. It is estimated that to maintain the empty hardening furnace at 150 deg. C. a load not exceeding 15 kW will be required, and that to maintain the empty tempering furnace at a temperature of 650 deg. C. 13 kW will be required. The energy required to heat the hardening furnace charged with eight tyres weighing approximately 3½ tons from 15 deg. C. to 850 deg. C. will not exceed 825 kWh, and the time to attain this heat will be approximately 3½ hours. The energy required to heat the tempering furnace from 200 deg. C. to 650 deg. C. will be approximately 450 kWh.

Electrical Layout in Collieries. By J. F. H. Colyer, A.M.I.E.E.

MINING electrical engineers are chiefly concerned with economical production, a reliable supply, and the efficient use of electrical power in collieries. Continuity of supply is very important, and freedom from breakdowns depends to a very large extent on the layout of the distributing system. The system of supply adopted at all modern collieries is three-phase a.c. with earthed neutral. The use of the earthed neutral permits the satisfactory employment of discriminative earth-leakage protection; it gives on the whole greater reliability and it also simplifies compliance with Coal Mines' Regulations 126 (b).

[*Elliott & Fry*

Mr. J. F. H. Colyer is contract manager to W. T. Henley's Teleg. Works Co., Ltd., and president of the London branch of the Association of Mining Electrical Engineers

In a modern distributing system, whether for use with plant on the surface or in the mine, three-phase or multicore wire-armoured cables are used wherever possible. The use of v.i.r. leads or bare wires on poles is generally limited to parts of the surface lighting system, with occasional medium-voltage and e.h.v. overhead lines to isolated parts of the surface. In the mine the use of unarmoured cables is ruled out by the 1911 Regulations. The present practice is to make the electrical system as nearly as possible an armoured system throughout, all live conductors being enclosed in a bonded and earthed metal sheath, thus reducing the dangers from fire and shock. This principle is applied from the main switch-gear at the surface right up to the apparatus to be supplied, whether installed on the surface or below ground.

On large systems power is generated at 3.3 and 11-kV and is transmitted to the collieries after transformation at 33, 22, 11 or 3.3-kV, depending on the amount of power transmitted and the distance. It is generally taken that 3.3 kV is sufficiently high for main distribution in and about the colliery. There are rare cases of motors working at 11 kV on the surface, and of 6.6 kV being used on the surface and underground.

The general practice of large colliery groups is to carry out main distribution at 3.3 kV at which motors of 50 h.p. and upwards are supplied, and to transform to 550 V for motors below 50 h.p. For lighting, the higher voltages are transformed down to 110 V. No matter at how many points transformation is effected the neutral point of the lower-voltage system is earthed, and where, as in some cases for lighting, single-phase transformers are used the mid-point of the lower-voltage system is earthed.

Two principal types of switchgear are used: (1) Air-break switches with fuses, or air-break automatic circuit-breakers. The use of air-break switchgear in mining practice is limited to medium or low voltages and small amounts of power, all live parts being enclosed in cast iron or mild steel casings; (2) Oil-immersed switch or circuit-breakers; this type is being used on all modern switchboards, as larger amounts of power can be safely controlled with smaller overall dimensions, and for greater rupturing capacities.

For surface switchboards, the cubicle type of concrete and metal or all-sheet metal enclosure has been adopted in the past, but now the most favoured design is the draw-out metal-clad type, in which live conductors are enclosed in an earthed metal enclosure, thus minimising the danger of fire and shock. It takes up less space, is more robust, is simpler to operate, and is fitted with more efficient interlocks. These combine to make the operation more or less mistake-proof.

Flame-proof draw-out metal-clad gear is used underground and, in normal use within the usual rated capacity, gives very little cause for anxiety. It is under abnormal overload or fault conditions that a circuit-breaker is really tested; on some of the larger colliery systems the increased forces available in such cases have become a serious problem. To deal with this larger main switchgear can be installed on the surface, but for auxiliary surface and underground switchgear it is not economical or desirable to increase the size of the switchgear, so that for its protection reactances are installed which limit the kVA under short-circuit to a figure within its rated rupturing capacity. These reactances are fixed on the surface and can be of the single-phase air-core cast-in-concrete type, but the type more in keeping with the armour-clad type of construction favoured by colliery engineers is the three-phase, ironless-core, oil-immersed form enclosed in a boiler-plate tank.

The foregoing references to rupturing capacity do not apply

to the same extent to 550-V and 110-V systems; transformer capacities are much smaller, so that the maximum short-circuit kVA is well within the rated capacity of the switchgear used. The impedance of the feeder cables has a greater limiting effect at low voltages, but generally on e.h.v. systems the reactance only of the feeder is taken. This really becomes, with the same impedance, a question of comparative voltages.

Distribution Cables

Single- and double-wire-armoured cables are the only permissible types for general distribution in the mine, unarmoured cables being ruled out by the Coal Mines Regulations, 1911, except as trailing cables for portable apparatus. Even for underground lighting at low voltage, s.w.a. cables are now always used, and they have superseded screwed conduit on the surface for workshops, screens and washeries, where a strong mechanical job is required. For cables other than trailing cables, lead-sheathed and armoured impregnated paper-insulated cables are recommended because of their greater reliability and increased current-carrying capacity.

Where lead sheaths are liable to deterioration through the action of contaminated waters and other corrosive agents, bitumen sheathings should be employed. Cables entirely insulated with bitumen are not now generally regarded favourably, because of the low current density at which they must operate in order to avoid the risk of decentralisation of the conductors.

As high temperatures and, in the case of shaft cables, long vertical runs are encountered, "drained" impregnated paper-insulated cables (in which the amount of free impregnating oil is reduced to a minimum) should be installed, to prevent the accumulation of an oil head which would produce dangerous hydrostatic pressures on the sheathings, possibly causing them to burst. Reliable v.i.r. armoured cables are also available for underground lighting installations.

The numerous forms of trailing cables available for portable plant (*e.g.*, coal cutters) include some form of continuous earthing conductor throughout the length to conform with safety regulations, and a sheathing of tough rubber which is highly resistant to damage through abrasion, compression and blows.

On the system of one large colliery group, the practice is to use paper-insulated lead-covered and wire-armoured cables for all main and auxiliary feeders, whether h.v. or l.v., and all p.i.l.c. feeder cables have the B.O.T. copper earth shield under and in direct contact with the lead sheath; thus the bonding and conductivity of all metallic sheaths is materially improved, and the Regulations are more than complied with.

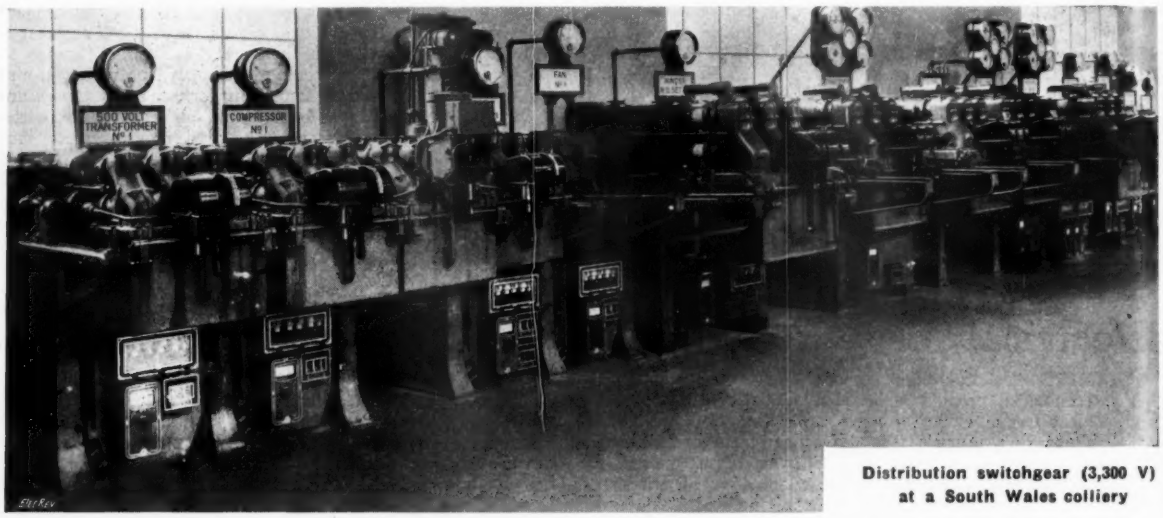
More importance is attached to really efficient bonding than to earth plates. In other words, indifferent bonding and low-resistance earth plates are a greater danger than low-resistance bonding and indifferent earth plates. A section of the lead sheathing of the cables between two earthing points may become comparatively insulated through defective bonding and under fault conditions would become dangerous. Plumbing is rarely permissible for connecting bonds to the cable sheaths, and various forms of mechanical bonds are employed.

The use of bitumen or rubber-bitumen and rubber-insulated cables is restricted to medium- and low-voltage supplies, and then only for semi-portable or portable apparatus, lighting circuits and certain connections between starting switches and motors. For shaft cables the usual sizes are 0.1, 0.15 and 0.2 sq. in., all p.i.l.c. with B.O.T. shield and d.w.a. Shaft cables, specified for vertical use, have sector-shaped conductors to reduce the overall diameter and therefore the weight of the cables.

If a shaft cable is installed behind the byats or buntons it is lowered on a steel rope attached to a power-driven winch. The cable is attached to the steel rope with rope ties every 10 to 15 ft., care being taken to keep it free from loops, and to ensure that it does not have to support itself for a greater distance than the spacing of the rope ties. After lowering into position the cable is cleated, commencing from the top end, the ties being removed as the cable is transferred from its temporary supports.

Inbye feeders are usually 0.05, 0.075 and 0.1 sq. in. These have sector-shaped conductors from 0.075 sq. in. upwards. The sections are kept as long as possible, from 350 to 400 yd. having been installed in sizes up to 0.1 sq. in. These cables are usually installed on the evening or night shift, arrangements being made with the colliery manager to have as many of the men on the shift as possible. Sometimes sixty to a hundred men are obtained. The drums are taken as far inbye as possible, and the men are then spread over the whole length of cable and carry it into position. In this way cables have been carried for distances of 1,000 yd., and it is found the best method to adopt.

Where there is reasonable room along the roadways the cables are hung along the roadside out of harm's way. Where there is considerable traffic and derailment of trams, the cables can be buried in the roadside and protected by cover boards, but this practice is very seldom adopted, and is not to be recommended. The safest, but most expensive, method to adopt where cables have to be buried is to install them in 4 in. steel pipes. The method of installation is, first, to lay the cable out into position, and then to thread the pipes over the cable, starting from each end; two men per pipe are ample. The pipes are 12 to 15 ft. long, so that the jointing up of the pipes commences from the middle of the cable. The type of joint used is called the "Williams" joint, which permits any deviation from the straight run. Jointing is carried out in properly made recesses in the roadside. Joint boxes are fixed on brick pillars and then surrounded by a larger cast-iron box or brick shell filled with sand or stone dust.



Distribution switchgear (3,300 V) at a South Wales colliery

Overload and Fault Protection

The usual overload protection is adopted; in addition, earth-leakage protection is provided only on high- and medium-voltage feeders for underground. For main shaft feeders the earth leakage is set to 60 per cent. of the normal rating of the feeder. For inbye feeders core-balance earth leakage set to 20 per cent. approximately is chosen, and for haulage motors, pump and transformers, 5 per cent. to 10 per cent. core-balance earth leakage is adopted. Merz-Price or Merz-Hunter fault protection is not used except for main distribution systems interconnecting the colleries.

In practically all cases reactances are proportioned so that the maximum short-circuit kVA is limited to 20,000 at the pit bottom sub-station; with this limitation the standard mining panels can safely clear any faults and still retain their flame-proof properties, and, incidentally, cause less disturbance to the system under fault conditions. Where feeders are in duplicate, if the maximum short-circuit kVA exceeds the above figure, the cables are not always worked in parallel. The system is either split up or one of the feeders is kept alive for emergency supply only.

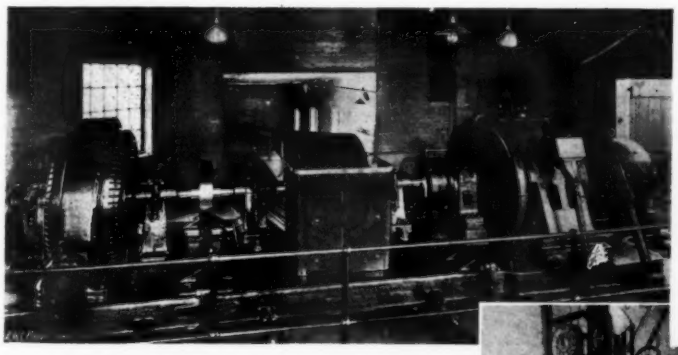
A Completely Electrified Colliery

THE Woolley Colliery, Darton, near Barnsley, of Messrs. Fountain & Burnley, Ltd., is a good example of the advantages of public electricity supply for collieries. The colliery electrician, Mr. S. Jebson, to whom we are indebted for his great care to show us everything, stressed the fact that in taking the whole of the electricity used from the Yorkshire Electric Power Co. they had been able to obtain favourable and economic rates, and thus gain relief from the undesirable responsibilities of electricity generation.

Three seams down the shaft at different depths are being worked, and the output of the colliery is 5,000 tons per day of two shifts. There is a total of 5,600 h.p. of motors installed, the maximum load is 2,000 kVA, and the load factor is 45 per cent. The greater part of the power (3,200 h.p.) is installed above ground, where by far the greater quantity of electricity is consumed. But coal winning begins at the face. Roads parallel with the seams radiate from the shaft and communicate with the working faces by gates running normally to them. The working faces average about 200 yd. long, and their distance from the road increases as the seam is worked at about 10 yd. per week. The seam depth is about 3 ft.

Drilling the seam by electrically driven boring machines, preparatory to shot firing, is the first operation. These portable machines, supplied by Siemens-Schuckert, are each fitted with a 12-h.p. motor and capable of drilling a hole of 2-in. bore and 54 in. deep. Next, machine cutters undercut by about 3 in. and to 6 ft. or so into, and along the whole length of, the seam. Mavor & Coulson, Anderson-Boyes, and Jeffrey Diamond cutters are employed.

Shot firing between shifts releases the undercut seam, and the coal can then be removed easily. While the cutting is in progress a shaker conveyor for down-seam transport and a continuous belt conveyor for up-seam work are built immediately behind and parallel with the face, their two meeting ends forming a junction with the gate conveyor. This is a semi-portable unit with a jockey pulley arrangement for varying the effective lengths of the belt, and it has to be moved as a whole nearer the face to meet the face conveyors, also during cutting operations. The normal equipment for a



200-yd. face includes one boring machine, a 40-h.p. cutter, a 15-h.p. shaker conveyor, a 7½-h.p. belt conveyor, and a 15-h.p. gate conveyor, the combined equipment being capable of producing and delivering 500 tubs, each with a net load of half-ton of coal, per shift.

A " run " of thirty or forty tubs is hauled at a time from the loading point to the main haulage road, the h.p. of the haulage depending on the gradient of the road. The particular equipment which we saw hauls over a gradient of 1 in 20 and is driven by a 25-h.p. motor. There is a main haulage for each seam, in one case 150 h.p. and in another 200 h.p., with three winding drums which can be separately controlled, in addition to which there are a number of auxiliary haulages along the roads and gates, varying up to about 25 h.p. each. The three inclined seams (downward from the shaft) are jointly in communication with the bottom of the pit shaft by a cross measure drift, which is inclined in the opposite direction so that the coal is brought up or down each seam and down the drift to the bottom of the pit shaft. The drift is equipped with a haulage at the junction. The haulage motors are of the B.T.-H. slip-ring type and controlled by tramway reversible control type equipment.

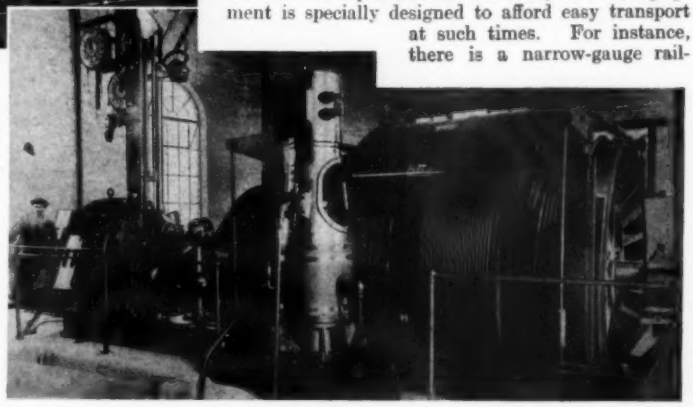
The mine is a particularly dry one, except in one seam where the pumping plant is installed. In the Haigh Moor seam 84 yd. from the surface there are three Mather & Platt 1,000-g.p.m. turbine pumps, each directly coupled to a 150-h.p. 1,450-r.p.m. slip-ring induction motor. In another seam 50 yd. below this there is a second pumping installation, and this delivers to the first station. The equipment in this case is a 25-h.p. s.c. motor and a 200-g.p.m. turbine pump combination. The h.p. installed for the underground services is as follows: Cutting 715 h.p., face conveying 238 h.p., gate conveying 106 h.p., haulage 855 h.p., and pumping 520 h.p.

A machine cutter at work at the face

For supplying the underground equipment there are two 0.075 sq. in. p.i.l.c. vulcanite bitumen served d.w.a. cables which are housed in the side of the shaft behind transverse girders to which they are cleated. All the main h.p. and l.p. distribution cables below ground are p.i., v.b.s., and d.w.a. (not l.c.), and those at the coal face, where a measure of flexibility is required, are v.i.r., d.w.a., and bitumen filled. For the coal cutters, &c., trailing tables are v.i.r. insulated with " Cracore " centres, and c.t.s. protection: they have four 0.0225-sq. in. cores and are fed in some cases from Ellison switches and in others from Metro-Vick. remote-control gate-end switches, from which each piece of portable apparatus can be isolated and is protected.

Underground Sub-stations

At the pit bottom there is a 2,000-V distribution switchboard, and near each coal face there is a sub-station with a main h.p. switch, a 100-kW transformer, and a number of l.p. feeder switches, all fitted with earth leakage protection equipment. About once in every six months the face sub-station is moved to a point nearer the face, and the equipment is specially designed to afford easy transport at such times. For instance, there is a narrow-gauge rail-



Left: This dual-motor solid-coupled fan drive provides for p.f. correction, two outputs and standby. Right: The 600-h.p. pneumatically controlled a.c. winding equipment

way down the gate, and the transformer carries rollers with the required gauge for this. Disconnecting type joint boxes with mechanical connections only are used, and it is thus a simple matter to add a further 300 yd. of cable when required. There is a total lighting load of 60 kW (110 V) throughout the workings, most of which is below ground. We were impressed by the particularly wide diffusion which we saw in the roads from the " Wigan " flameproof prismatic fittings supplied by Messrs. Heyes & Co., Ltd.

Ventilation, a long-period load, is effected from the surface, and the driving arrangements in this case are of particular

interest. The 300,000 cu. ft. per min. "Sirocco" fan is rope driven from a common pulley coupled to two motors, one on either side. Originally the 200-h.p., 290-r.p.m. B.T.-H. s.r. motor drove the fan at all times. Larger output was required during the week when power factor correction was desirable, and speed increase was requested. All these requirements as well as stand-by power were met in the scheme adopted. A 380-h.p., 375-r.p.m. Met.-Vick. synchronous induction motor is now directly coupled to the driving shaft, and during week-ends, when the fan is driven by the older motor, the larger motor is allowed to idle. Similarly the smaller motor idles during the week. The synchronous motor is designed to afford a normal power factor of 0.95 lagging for the whole installation. To assist in power factor regulation by altering the excitation current a p.f. indicator on the fan motor starting equipment is cabled right back to the main bus-bars at the sub-station for the whole supply. The two motors are electrically interlocked, so that it is impossible to switch either one in whilst the other one is on the line.

The up-cast coal winding shaft is served by a directly operated 600-h.p. winder, the motor speeds being controlled by a water-cooled liquid controller and pneumatically operated reversible contactors. For the air supply for the brakes and contactors two motor-driven compressors deliver to a common receiver. This equipment will wind ninety times per hour and the maximum cage speed is approximately 35 miles per hour. Two-deck cages are employed, and six tubs are brought up at one time. The downcast-shaft winding equipment, designed for seventy-two winds per hour, is somewhat similar, but at present it is governed by a weir-type liquid controller by which acceleration can be increased by increasing the rate of flow of water into the electrode compartment or by increasing the strength of the liquid; this winder is to be fitted with pneumatic contactors on the score of easier manipulation of the controls.

After being lowered to the screens by a motor-driven retarder, the tubs are received by rotary tipplers which discharge the coal on to shaker conveyors and screens, and all coal below 3-in. mesh is then conveyed to the washery, where it is washed on the "Rheolaveur" principle. About 100 h.p. is employed for the screening plant, and in the washery there is a total of 360 h.p. A 15-h.p. haulage system takes the residue from the washery to the dump.

A considerable amount of power is used for auxiliary purposes. For instance, in the engineering and wagon shops and the saw mill there are 15, 32 and 30 h.p. of motors installed, respectively. For drawing wagons in front of the screens and over the weighing machine a wagon winch driven by a mere 25 h.p. has displaced a steam locomotive. There is a motor-generator set for battery charging in the lamp cabin, and an arc-welding set for general repairs has proved itself an efficient labour-saver. Electro-pneumatic pick-sharpening equipment is a further addition, and the company has its own vulcanising plant for the repair of the trailing cables.

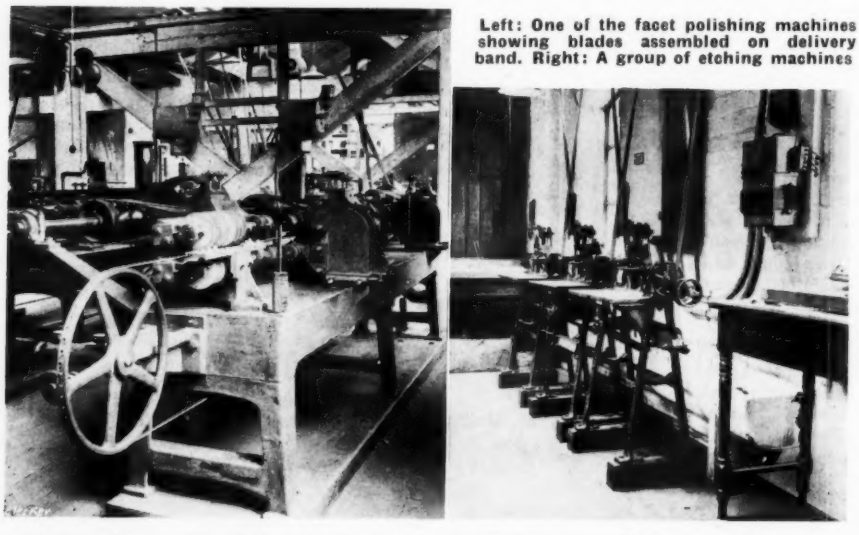
A survey of the consumption figures reveals that the proportions are: Winding one-third of the total consumption; ventilation one-third; and cutting, conveying, screening and washing one-third. There is now a total of 5,600 h.p. installed throughout the colliery, to which there are four independent and separate sources of supply from the Y.E.P. system. The power company carried out the whole of the electrical work.

Making Razor Blades

IT is by no means the size of the factory nor the size of the product which indicates the importance of a class of manufacture to the electrical industry; the production of safety razor blades is a good illustration of this.

We recently visited the up-to-date factory in Sheffield of Messrs. G. Ibberson & Co., where many thousands of blades are produced per day, and the total h.p. installed is about 25. Steel blanks, previously hardened and tempered, which are received with the holes already made, are first "rumbled," *i.e.*, they are revolved in wood drums with pieces of leather and lime, and in this way all traces of oil are removed.

Next, the blades are acid etched and each of a number of machines performing this duty will deal with 30,000 blades per day. A 2-h.p. motor is capable of driving a battery of six etching machines. After being passed through a neutralising solution to remove all acids, the blades are treated in centrifugal washing and drying machines in which they are mounted on spindles which are revolved at 3,000 r.p.m.



Left: One of the facet polishing machines showing blades assembled on delivery band. Right: A group of etching machines

Semi-automatic grinding is the next operation, for which the blades are loaded on to the moving endless bands of the machines and are passed between grinding rolls which sharpen one edge in one direction, while similar rolls sharpen the other edge in the opposite direction. Each machine will deal with about 4,000 blades per hour. Machines similar in principle to the grinders, but with wheels faced with leather, polish the edge facets at high speed. They are driven individually by 2½-h.p. motors.

Finally, there are stropping operations and inspection. But inspection is carried out between all the processes referred to; indeed, we left with the impression that most of the labour put into the razor blade is in connection with cleaning and inspection. For the production of some 10,000 blades per hour there are, group driven from a 12-h.p. motor, four rumblers, five centrifugal driers, four grinders, four stropping machines, and also a razor crown riveting and polishing machine, in addition to two small lathes and factory service machines. There is also a cylindrical grinder with a 7½-h.p. motor.

Lighting is of extreme importance, particularly in connection with the final and inter-operation, inspection of edges. The edges, at each successive stage of manufacture, are examined by highly trained girl operators, each girl being provided with an inspection box or chamber, some four feet square, ventilated at the top, and with one side open sufficiently high to permit the operator to sit comfortably at the open side. Each box is painted dead black inside except for the bottom or working surface, which is provided with a green covering.

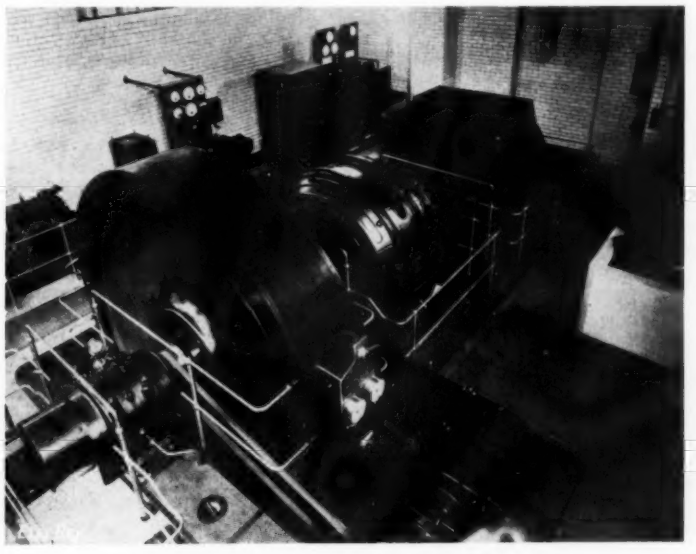
The boxes are so placed, relative to the natural lighting of the room, that no direct rays enter. One 100-W pearl lamp provided with a reflector is suspended in each box in such a position that it is between the eyes and the hands of the inspector. The edges of the blades are examined in bulk, and, by means of the lighting arrangement provided, it is possible to concentrate an intensive beam of light upon them without eye-strain to the operator. When the light beam, so directed, falls upon a group of edges the facets of which are regular and the apices true the rays are absorbed by the facets, with the result that the bulk has the appearance of black velvet. Should any blade have a distorted, imperfect or ragged apex it reflects the light back to the operator's point of vision in the form of a "white line" or some other appreciable form of reflection.

It will be appreciated that other factors such as fineness of structure and degree of hardness of the steel from which the blade is made, the depth and direction of the almost infinitesimal lines which make up the polished surface of the facets and their conjunction at the apex, and, above all, that indefinable quality known as "feel" contributes largely to the final quality of a blade, but that of inspection by reflected light appears to be the most generally useful.

Steel Rolling Mills

THE precise control essential for modern rolling mill driving is such that the electrical method is the only really efficient one, and absolute evidence of this was recently secured at the extensive mills at Sheffield of Messrs. Brown Bayley's Steel Works, Ltd., where we saw some particularly interesting equipment. Of the total consumption for the factory of 12,000,000 kWh per year something like 3,000,000 kWh is devoted to the rolling mills and the allied operations.

From open-hearth gas or electric arc furnaces, according to the quality of the product, ingots measuring about 5 ft. long and 14 in. square are obtained and supplied to the mills. Ninety per cent. of these ingots go directly to a 27-in. reversing cogging mill in which they are reduced to any size down to 2 in. square or the equivalent in "rounds" or "slabs." This mill is served by a 2,000-h.p. reversible motor which was supplied by the English Electric Co., Ltd. It has a maximum speed of 70 r.p.m., and is capable of carrying peak loads of up to 12,000 h.p. It is air-cooled, 20,000 cu. ft. of purified air being passed through the machine per minute. The armature and shaft weigh about 50 tons, and the bearings carrying this weight are pressure lubricated by oil pumps contained in an underground chamber, oil in the bearings being maintained at 200 lb. per square inch, so that the shaft actually floats in oil and is lifted from the bottom bearing by 0.02 in.



Flywheel convertor set for 27-in. reversing-mill drive

Power is transmitted to the mill through a flexible Wellman Bibby coupling. The mill was modernised recently, new pinions, spindles, electric screw-down gear, &c., being fitted in the three weeks during which the mill was idle. The output from the mill averages 116 tons per shift, and the power consumed is 32 kWh per ton. For supplying the motor there is an Ilgner flywheel equalising set which consists of a 2,000-h.p., 11,000-V induction motor directly coupled to a variable-voltage generator supplying the mill motor at any pressure up to 500 V d.c.

Directly coupled to this machine is a 20-ton flywheel, the bearings of which are also pressure lubricated. The effectiveness of this method of lubrication is illustrated by a test-bed trial when a weight of only ¼ oz. placed on the rim of the wheel started it in motion. The generator is separately excited by a machine through which, with the master controller, the mill driver on his observation platform has complete control of the whole of the plant. The set runs at from 480 to 600 r.p.m., the rolling load lowering the speed, and the energy given off by the mill motor when the mill is slowing down helping to speed it up again. The set is cooled by purified air, 30,000 cubic feet per min. being supplied by an automatic self-cleaning viscous-type purifier.

According to the final sizes of bar required, billets in various sizes from the 27-in. mill are fed to other mills for further reduction. For instance, a 14-in. three-high bar mill with a 40-ton flywheel is driven by a 2,000-h.p. variable-speed motor of English Electric manufacture. It is a 460-V d.c. machine supplied direct from the company's substation, where the 11,000-V three-phase supply is converted to d.c. at the motor pressure. The starting equipment for this motor was supplied by the Metropolitan-Vickers Electrical Co., Ltd.

A 12-in. three-high bar mill for rolling 4-in. billets down to spring, round and square sections, is another example of steam to electric conversion. It is driven by a 250-h.p. motor supplied by the Electric Construction Co., Ltd., with Metropolitan-Vickers starting equipment, and the production is about eight tons per shift. The 14-in. three-high bar mill is primarily employed for rolling spring steel, and it has an output of 50 tons per shift, but it also rolls squares and rounds, strip and other sections from the 6-in. blooms from the 27-in. reversing mill.

We saw many rolling mills, particularly in connection with the production of stainless steel articles; a good example is No. 2 sheet mill which is equipped with 27¼-in. diameter rolls and is capable of producing sheets of stainless steel in sizes up to 8 ft. by 40 in. by ¼ in. thick at the rate of about 10 tons per week. It has two motors of 250-h.p., each capable of carrying up to 100 per cent. overload. These motors, supplied by the Electric Construction Co., Ltd., with Metropolitan-Vickers starting equipment, drive through oil-immersed reduction gears, the whole making a very fine example of small modern mill driving.

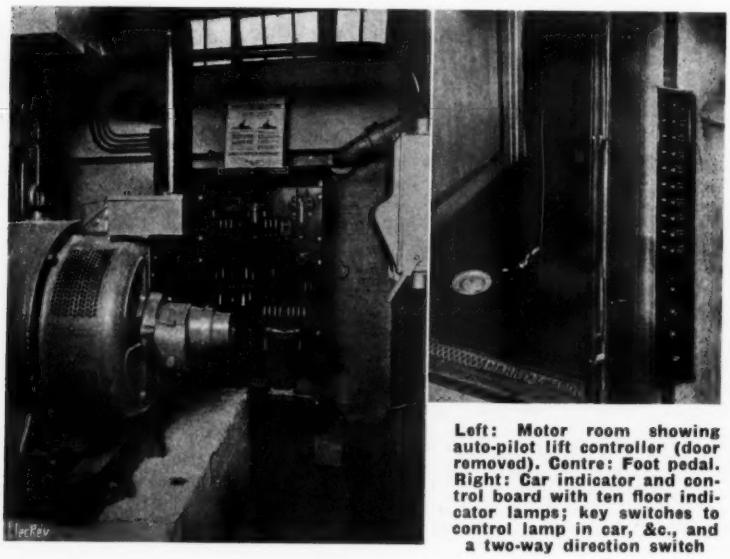
A 9½-in. three-high bar mill rope-driven by two 250-h.p. motors

In the stainless-steel sheet department there are in constant service, twenty-four hours per day, seventeen electrically driven sheet polishing machines which are responsible for the consumption of about 20,000 kWh per week. This is believed to be the largest installation of its kind in Sheffield.

Lift Control. By H. Marryat, M.I.E.E., M.I.Mech.E.

MODERN methods of lift control arise out of the demand for greater speed of travel and operation to meet the requirements of larger and higher buildings. Every increase of speed reduces the floor area and attendance required by the lift service. To increase the car speed alone goes only a small way towards improving the overall speed. Methods must be devised to reduce the time occupied in acceleration and deceleration. This has necessitated multi-speed motors and multi-voltage control and its derivatives.

As the rate of deceleration is increased, the problem of accurate floor levelling becomes more acute. To avoid waste of time, various methods of automatic levelling have been devised. These usually involve an auxiliary motor which comes into operation within a short distance of the desired floor in such a manner as to bring the car to floor level at very slow speed and maintain it there. The rapid handling of passengers is as important as speeding up the machinery. Devices are introduced to enable the attendant to operate two or more gates by a single movement, or they may open and close automatically.



Left: Motor room showing auto-pilot lift controller (door removed). Centre: Foot pedal. Right: Car indicator and control board with ten floor indicator lamps; key switches to control lamp in car, &c., and a two-way direction switch

Automatic Operation and Interlocking

With the simplest form of car-switch or press-button operation the connections of a lift to meet modern requirements are already complicated. They are rendered more so by the adoption of any of the various methods of automatic operation mentioned later, and by the fact that the whole complement of solenoids, contactors, relays, &c., must be so interlocked that any possible fault arising out of any combination of circumstances can result only in the stopping of the lift till the fault is cleared. The complication is further involved by the necessity for providing against the possibility of current set up as the result of any fault or combination of faults, or regenerated by the motor, having sufficient voltage to retain any solenoid or relay which should normally be in the off position.

Rapid deceleration of sufficient smoothness to avoid unpleasant physical effects may be obtained by means of multi-voltage control. A motor generator designed to give a number of d.c. voltages is employed to supply current to a group of lifts, and the various fixed voltages are successively impressed upon the armature circuit of the lift motors to effect acceleration and speed regulation.

Generator-field Control Systems

Generator-field control requires a separate generator for each lift so arranged that a variable voltage is applied to the motor by varying the strength and direction of the generator field. A damping motor is sometimes employed to retard the building up of the generator field and to hold it up after the field switch is opened. This motor is fitted with a flywheel, and the armature is connected across the field of the generator. Another variation of generator-field control is series-exciter speed regulation, which employs a small d.c. exciter, the field winding of which is in series with the armature circuit of the motor, and the armature in series with the field circuit of the generator. In these systems an armature switch may be so arranged as to reverse the generator field when the armature circuit is opened in order to bring the generator voltage more quickly to zero.

Methods of operation have developed even more quickly than methods of control. Ordinary push-button automatic operation is only suitable for private houses or buildings where the traffic is light, because from the moment a passenger has initiated a call by pressing a button the lift remains at his disposal alone. The car-switch operated lift with an attendant can be stopped at various floors to pick up waiting passengers. In this case push buttons on the floors may operate an indicator in the car, a system which may be greatly improved by installing two buttons at each waiting place, for the use of passengers wishing to travel upwards and downwards respectively, to enable the attendant to stop at those floors only where passengers are waiting to go in his direction.

An improvement upon this system and a very simple method of operation, particularly applicable to high-speed traffic, is termed the "Auto-Pilot." This method of operation ensures accurate floor stopping independently of any skill on the part of the attendant. Indicators are provided in the car to announce the floors at which passengers are waiting. A small two-way switch in the car directs the travel either upwards or downwards. To start the journey the attendant has only to place his foot upon a floor pedal, thus leaving his hands free to handle the gates. On nearing a floor at which a stop is required, he removes his foot from the pedal and the car automatically stops at the correct level.

The next step in complication of the wiring diagram is to effect this result automatically, so saving the expense of attendance. One push is fixed on each floor, and one for each floor in the car. The momentary pressure of any button registers a call, and no matter how many buttons are pressed, or in what order, every call will be answered by the car in exactly the same sequence in which the buttons have been pressed. This is called "non-selective-collective automatic" operation.

Selective-collective-automatic operation involves "up" and "down" buttons upon each floor, and one button for each floor in the car. Every button pressed registers a call as before, but the stops made automatically by the car occur in the order in which the various landings are reached in the direction in which the car is travelling, and calls made for travel in the opposite direction are answered in the order in which the landings are reached on the return journey. A modification of this system is termed "down-collection operation." The lift is operated as an ordinary automatic lift as regards all journeys in an up direction, but down calls are registered and collected automatically. This method of operation is very suitable for buildings in which there is little inter-floor traffic.

[*Elliott & Fry*

Mr. H. Marryat is a director of Marryat & Scott, Ltd.

The Pre-register Method

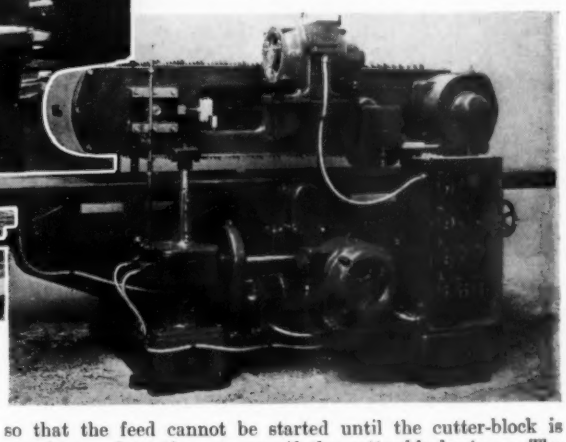
A method of operation suitable for very busy lifts is termed "pre-register," and requires an attendant in the car. A press-button call from any floor or from the car is registered in advance, and when the car nears that floor the attendant is advised by a signal, which may be visible or audible; he then initiates the stop which follows automatically.

Signal operation marks a further advance for dealing with heavy traffic. The button arrangement is the same as for the pre-register system. The attendant starts the lift, and the passengers call out the numbers of the floors at which they wish to stop. The attendant presses the corresponding buttons, and these calls, together with any made by waiting passengers at the various landings, are all responded to by the car stopping at the respective floors in the order in which they are reached, irrespective of the order in which the buttons have been pressed. In the case of a group of lifts ranged side by side, the floor buttons can be so connected as to cause the next car passing in the desired direction to stop

A Modern Woodworking Mill. By W. L. Sims, A.M.I.E.E.

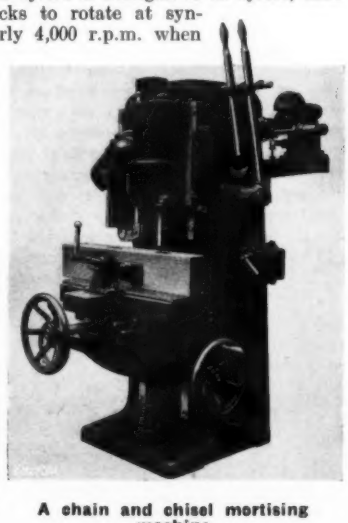
THE woodworking mill of Messrs. Boots, Ltd., Nottingham, in which is produced high-class joinery such as shop-fronts, office and shop furniture, etc., is entirely equipped with individually electrically driven woodworking machinery, many of the machines having a separate motor for each movement. The total of 465 installed horse-power is made up of motors ranging in size from 1 to 25 h.p., and excludes motors used for dust and chip extracting equipment.

Mahogany, teak and oak are mostly already broken down when received, and stored in sheds adjacent to the mill, although some is converted to planks on site. In the mill proper the timber is selected and marked off, and in the machine shop it is first cross-cut to length, and ripped. It then passes through surfacers and thicknessers, before being handled by batteries of dimension saws, spindle moulders, tenoners, mortisers, dovetailers and sanders. The timber is then dealt with, in turn, in the joiners' shop for assembly, in the spraying and polishing departments, and in the finished stores for despatch, the output being about 85 tons of hardwood joinery per month.



Left: A straight-line edger which rips at 150 ft. per minute Right: A finger-feed planer for treating timber "in wind"

For some of the planing and thicknessing machines the standard frequency of 50 cycles is changed to 66 cycles, thus enabling the cutter-blocks to rotate at synchronous speeds of nearly 4,000 r.p.m. when driven by directly coupled two-pole induction motors. High cutting speeds considerably improve the finish of the planed timber.



A chain and chisel mortising machine

Installation power factor improvement to 97 per cent. is effected by a G.E.C. frequency-changer set, which consists of the changer mounted on a bed plate with, and directly coupled to, a self-starting synchronous motor and a d.c. exciter. A high-speed router has a small induction-type frequency changer (400 cycles) built into its base and connected without switchgear to a 1-h.p. two-pole motor, which runs at 24,000 r.p.m., in the head of the machine. The machine is operated by a straight-on contactor starter, with remote push-button control. The head motor starts up in step with the changer. The machine is chiefly used on cutout work such as cabinet frets or raised and sunk panels. The work is clamped to a plate, the underside of which is a jig, which, after the tool has entered the work, follows a former pin projecting through the table, so that the part to be removed is cut or routed away.

Timber "in wind" (twisted along its length), if passed through a planing machine with heavy feed pressures, would straighten itself when passing over the cutter-block, and take up its twist again after leaving the machine. So the feed mechanism of a finger-feed planer consists of an endless band of spring controlled fingers, which adjust themselves to the varying shape of stock being passed through the machine, and feed it through without distorting it. Usually only a light cut is taken, and when the side to be surfaced is not completely cleaned up, owing to excessive twist, the piece is returned to the feed-in end of the machine, over the top of the endless band. The cutter-block is driven by a 7½-h.p. two-pole motor, the endless feed band by a 3-h.p. six-pole motor, while the feed band is raised and lowered by a 1-h.p. six-pole motor.

Control is by contactors operated from a push-button station in the front of the machine, having "start cutter-block," "start feed," "raise feed," "lower feed," and "stop machine" points. The feed mechanism is electrically interlocked with the cutter-block, so that the feed cannot be started until the cutter-block is running, and continue to run if the cutter-block stops. The raising and lowering mechanism is fitted with overrun limit switches, so that the fingers cannot be lowered into the cutter-block or raised too high. The 7½-h.p. motor has a star-wound stator, with an auxiliary starting winding in series, each phase being arranged so that the total number of turns produces the same flux as an equivalent delta winding connected in star. The current does not exceed twice full load at starting, and at least the same starting torque is obtained as by star-delta starting. In this way, for automatic equipment, only two contactors are needed, as against three for star-delta starting, the first contactor closing the complete winding across the supply, and the second contactor "shorting" the starting winding. The motor is not disconnected from the line during the starting period, and interlocks are not required to prevent the delta contactor getting home before the star contactor has broken its arc. (See ELECTRICAL REVIEW, May 20th, 1932.)

A straight-line edger rips up to speeds of 150 ft. per minute, and the sawing is sufficiently accurate to enable glue joints to be made without further machining. The saw is driven by a 15-h.p. motor, and the feed mechanism by a four-speed change-pole motor. Control is by remotely operated contactors.

A Saw-welding Machine

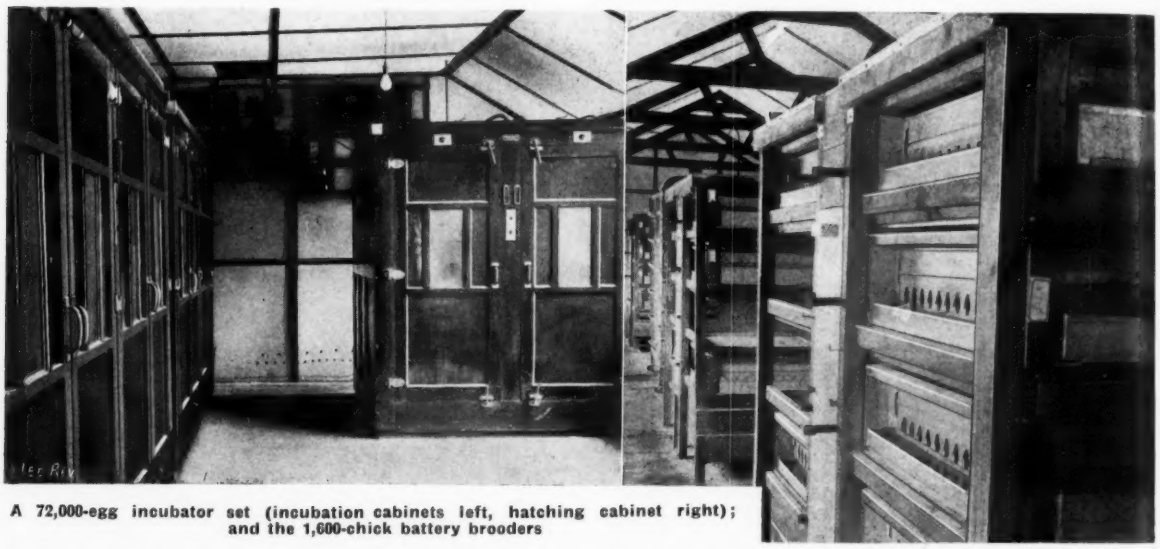
In a machine used for brazing broken band saws, the two ends of the blade are placed in the machine and clamped down, a piece of ribbon solder being inserted between the lapped ends. When the blade is in position it completes what is, in effect, the secondary winding of a single-phase transformer with only one turn. The primary winding is connected to the supply through tappings to a four-position switch, so that the current through the secondary winding, and hence the heat in the blade, can be graduated. When the solder has melted the joint is pressed between jaws operated by the handle and the heat is switched off gradually, so that the blade will not be brittle near the joint.

A chain and chisel mortising machine has a 4-h.p. built-in motor on the chain, and a 2-h.p. unit on the chisel, the chisel motor being vertical with the tools directly mounted on the motor shaft end, and the chain motor horizontal and driving the chain sprocket through bevelled gears. Either tool is drawn downwards towards the work by selecting the appropriate handle. This action automatically starts the selected head by closing a pilot switch operating a direct-on contactor in the machine. Raising the tool from the material being operated on automatically stops the motor.

Electricity, the Foster Mother

A safe and convenient system

THE consumption of 5,000 kWh during the March quarter of this year at the Hall Mark Hatcheries, Wickford, Essex, indicates the importance of the chicken-farming business to the electrical industry, particularly as the load is a 24-hour one. True, these are the three heavy months of the year, but electricity is used extensively all the year round. Briefly, the main "processes" for which electricity is used are incubation, brooding and hovering, and approximately three weeks is required for each.



A 72,000-egg incubator set (incubation cabinets left, hatching cabinet right); and the 1,600-chick battery brooders

There is a total egg capacity of 128,000 in the incubator plant, which is made up of one 9,000, two 23,500 and two 36,000-egg Robbins cabinets. The two largest incubation cabinets are operated in conjunction with a separate hatching cabinet, the three units together forming a "set." Each of the other cabinets has its own hatching compartment within the main structure.

The Heating Arrangements

After a period of eighteen days of incubation the eggs are tested and the fertile ones removed from the incubation to the hatching compartments or cabinets, as the case may be, and the hatching equipment will deal with about one-third of the eggs in the corresponding incubation equipment, the setting of the eggs and delivery of the chicks being arranged on a batch relay principle.

The largest incubators and 23,000-egg combined incubators and hatchers are each equipped with two 500-W heaters, the cabinet measurements being 6 ft. 7 in. high, 6 ft. 10 in. deep and 10 ft. 10 in. long, while the smallest combined cabinet and the separate hatcher for the largest incubators are each served by two 220-W heaters within a cabinet of the same height and depth and measuring 5 ft. 5 in. long. The constructional features are practically identical for all of these appliances.

A 200-chick canopy hover

A few turns tilt the egg trays at 45 deg. from the horizontal in either direction Internal lighting for inspection, pilot lighting for element "on" and "off" indication, and indicator switches for the fan and the lighting are other features of each cabinet. At the end of every hatching period a great deal of fluff has to be removed from the equipment, and electric vacuum cleaners are found to be very useful for this purpose.

During testing for fertility the trays of eggs are slid over two 100-W lamps arranged in a special inverted intensive reflector built into a table-like structure. The clear or unfertile eggs are easily discernible in this way. After testing, the fertile eggs in the tray are covered by another tray and completely turned over. On the new tray is placed a mesh lid which prevents the chicks from mixing, and the whole is then transferred to the hatcher.

Chicks that are not marketed as "day olds" are immediately transferred to automatic electric battery brooders where they spend their first three weeks of life in a temperature of up to 85 or 90 deg. F. (high set). These batteries were made by Messrs. Martin Harvey to the design of Mr. F. Bowers, proprietor of Hall Mark Hatcheries and a keen advocate of electricity for chicken rearing. Indeed, he told us that if he could get electricity at an economic rate he would not think of using any other form of equipment. In his recent work "Plain Poultry Science" Mr. Bowers says: "I am convinced that it is the kind of heat rather than the amount of heat which ensures comfort to birds, and I am quite convinced that in the electric battery at 70 to 75 deg. F. the chicks are far more comfortable than would be the case under a hover where crowding would most certainly occur at that temperature, room conditions being equal."

Each battery has four four-tray banks, one bank at each corner. Each tray will accommodate 100 day-old chicks, so that the whole battery will house 1,600 chicks. The two banks on each of two opposite sides back on to and communicate by shutter-controlled holes at each tray with a central trunk. In this trunk is an inner chamber in which are arranged horizontally six (three on either side) 220-W tubular heaters. A fan in the horizontal plane immediately and centrally over the heating chamber circulates air downwards through the heating chamber and, in turn, upwards through the trunk outside the heating chamber to the trays or cages, the air being directed at each of the trays by a suitable louvre.

The heaters are controlled automatically as a whole to within ± 2 deg. F. by a protected thermostat in one of the trays, and, roughly, they are in circuit for about half the time. The fan operates quite independently of the heating, and there is a pilot-light on and off indication for the elements.

The Second Three Weeks

Birds from the battery brooders spend their second three weeks of life in runs under cover, each run measuring about 12 ft. by 10 ft., accommodating 200 chicks, and being equipped with an electric canopy hover. Under the canopy top or cover, which is 52 in. in diameter, each hover has a 300-W resistor coiled and secured to the under side of an asbestos board which is lagged at the top. Warmth is thus projected downward on to the chicks, suitable guard protection from the elements being provided.

There is an automatic thermostat secured to the under side of the canopy, outside the diameter of the element board, and the element is controlled as desired within temperature limits of 60 and 100 deg. F. As an experiment external neon lamps have been installed for "on" and "off" indication, and have been proved worth while. After their allotted period under the hovers the chicks are ready to face life in the open, certainly none the worse for their artificial foster mothering.

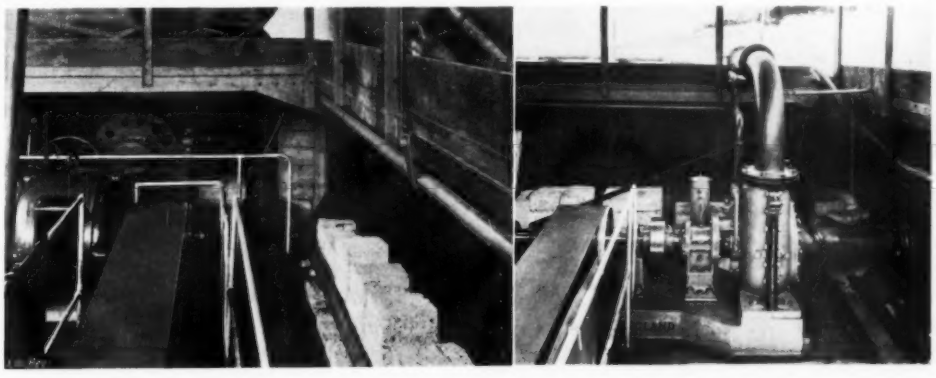
Gravel Pit Operations

THE flexibility of electric driving is well demonstrated at the workings of the Surrey Sand & Gravel Co., Ltd., at Thorpe, nr. Egham, where from the 250-acre site gravel and sand are removed to the extent of 75 tons per hour, digging, pumping and crushing and screening being the principal operations. Under a top surface a few feet deep the gravel and sand strata exist to a depth of about 20 ft. At first in a given section the required material is excavated, but when a pit of sufficient size is formed it is partly filled with water, to some extent by natural drainage and also by pumping.

From the bottom of the lake so formed a mixture of water and "material" is pumped *via* a pipe line to a screening plant in which the various sizes of gravel are separated and delivered to overhead storage equipment for lorry loading. The water and sand mixture running through the screens is by-passed to a sand-settling bin from which the water flows over a weir back to the lake and the sand is removed by cranes and put into storage. The large pieces of gravel or "rejects" are also by-passed to a crushing plant before being elevated to the screens for grading. For removal of the useless top material and also of the gravel and sand in the early stages of preparing a pit there are a Ruston Bucyrus excavator fitted with a 30-ft. jib crane and a ¾ cu. yd. bucket, and a Ruston "Skimmer-Scoop" with a 20-ft. jib crane and a similar bucket. The latter is used for practically only horizontal scooping in depths of not more than 8 ft. In each of these equipments the power unit is a 32-h.p. cold-starting Diesel engine running at 800 r.p.m.

One of the pontoons and pipe line

At each pit or lake the pumping equipment is housed in a steel pontoon, and it will be sufficient to refer to one only of these equipments in detail. The pontoon is 27 ft. long and 14 ft. wide, and an 8-in. Robuston pump is belt driven by a 160-h.p. slip-ring protected motor, controlled by an oil circuit-breaker and a drum-type controller. This pump has a manganese steel impeller, liner and delivery bend. The normal loading of the pump is 120 h.p., but often obstructions have to be met with, hence the additional power. The pump is believed to be unique in that it has roller-type bearings, which have proved very satisfactory in service, and in addition to reducing bearing friction and troubles a considerable saving in lubricant has been effected.



Gravel pump motor and friction hoist on pontoon, and (right) the electrically driven gravel pump

For raising and lowering the metal suction pipe on the drive there is a Hemel friction hoist, and for flushing the main pump there is a smaller pump with a 3-in. suction. Both the flushing pump and the hoist are driven by a 10-h.p. motor, the hoist drive being taken from a spur and a rawhide pinion on the opposite end of the shaft. The hoist speed is 80 ft. per minute. The drive is capable of pumping 75 cu. yd. per hour. The position of the pontoon on the lake varies; but pumping to the screening plant is effected at up to a maximum distance of 500 yd. For the rotary screens and the bucket conveyor to the screening plant, which have a capacity of about 75 cu. yd. per hour, there is a 15-h.p. motor. The crusher at the bottom of the plant is driven by a 30-h.p. motor, and it will deal with 25 cu. yd. (about 25 tons) per hour. This motor is mounted on the screener and is controlled by a starter located at ground level and emergency stop buttons at various points about the plant. It has been running almost continuously since it was installed and has had practically no attention.

The Diesel-driven generator sets

The electricity supply is derived from two six-cylinder Ruston and Hornsby cold starting solid injection Diesel engines. Each is of 225-h.p. and is directly coupled to a 152-kW, three-phase alternator, 50 cycles 415 V., supplied by Lancashire Dynamo & Crypto, Ltd. There is also a 5.7-kW exciter coupled in a similar fashion. For voltage regulation, operating in conjunction with a Metropolitan-Vickers switchboard regulator, there is a small auxiliary exciter belt driven from the main shaft, whose duty is to boost the field of the main exciter.

The average consumption of the engines is 1 gal. of fuel for each 13.5 kWh generated. Obviously this type of load is subject to very heavy fluctuations, and the attendant said that the operation was very satisfactory. Both engines normally run in parallel with ¾ full load for from 12 to 20 hours per day, and the power load is 420 h.p. The generators feed on to an open-front switchboard supplied by Messrs. Erskine, Heap & Co., Ltd., equipped with oil switches, synchronising gear and usual metering apparatus. There are three panels, two for the generators and one for the voltage regulation equipment, and the outgoing cables feed directly from the bus-bars of this board.

General lighting throughout the workings is supplied at 240 V from the main plant, but for emergencies there is a pilot system supplied from a 54-cell battery which may be charged from a small motor-generator set driven either from the main Diesel plant or a small Crossley engine.

The outgoing feeders to the equipment throughout the workings are simple wood-pole lines, and around the edges of the lakes at various points are Siemens junction boxes from which the special trailing cables for the pontoon equipment are fed. The trailing cables are permanently installed at the pontoon end. They were supplied by St. Helens Cable & Rubber Co., Ltd., and they are of the 0.25 sq. in. three-core flexible c.t.s. type. All the motors were supplied by Messrs. Crompton Parkinson, Ltd., and the starting equipment was manufactured by Messrs. George Ellison, Ltd.

Transport Problems Discussed

The Tramways, Light Railways and Transport Association Congress

THE thirty-seventh annual general meeting and the twenty-fourth annual congress of the Tramways, Light Railways and Transport Association were held in Southend-on-Sea on May 23rd, 24th and 25th. In the absence of the president, Sir Arthur Stanley, through indisposition, the proceedings were presided over by the chairman of the Council, Col. Sydney E. Smith, C.B.E. (director and manager of the Bristol Tramways & Carriage Co.).

There was an informal reception by the chairman of the Council on Wednesday evening, and on the following morning the Association was given a welcome by the Mayor (Councillor H. E. Frith), who indicated some of the road passenger transport problems which have to be dealt with in the town at the present time by pointing out that the resident population had grown from 12,000 in 1892 to 140,000, apart from the many hundreds of thousands of visitors. The chairman then extended a cordial welcome to the delegates who had come over from Paris to represent the Paris transport system, and M. Andries (assistant manager of the Paris Transport system) expressed his appreciation of the invitation, and desire to co-operate with British transport managers and engineers.

The Annual Meeting

Addressing the Association at the annual general meeting, the chairman said that in spite of a rather severe falling off in the membership of the Association at the beginning of the year, due to bad trade, the loss had been partly made up and the accounts showed a balance on the right side. In November last the Association was given the opportunity of submitting its views to the Ministry of Transport with regard to the simplification of procedure in cases where trolley vehicles were substituted for tramways and of tramway abandonment. He added that the procedure with regard to turning points was burdensome and costly, and said that an intimation had been received that while the Minister of Transport was willing to do something in this direction he did not apparently see his way to simplify procedure in the extension of trolley systems, which was a point upon which the Association was a little at variance with the Municipal Tramways and Transport Association.

Col. Smith remains in office as chairman for another year; new elections were made to the Council.

Ball and Roller Bearings

The remainder of the first morning was occupied with the reading and discussion of a paper entitled "Ball and Roller Bearings in Road Vehicles for Passenger Transport," by Mr. C. H. Smith, technical manager to the Hoffmann Manufacturing Co., Ltd., whose works were visited in the afternoon, together with those of Messrs. Crompton Parkinson, Ltd. The paper described the different types of ball and roller bearings, and methods of mounting, lubrication and protection. A list was given of many of the points of application to vehicles, the use of such bearings for trolley wheels and bases, tramcar axle boxes, and trolley-bus wheel hubs being described in detail. The paper concluded with a brief reference to causes of failure and their avoidance.

During the discussion the chairman said that at Bristol experiments had been carried out with ball and roller bearings for the past thirteen years, and, although it was not easy to adapt them to old tramway equipment, he had some Hoffmann bearings which had run very satisfactorily for 500,000 miles. Saving in current consumption in his own case had amounted to from 16 to 28 per cent. Mr. L. E. Harvey (London Transport) said that at Ilford his experiments with ball and roller bearings showed a total saving of £37 per car per annum, with current at 1d. per kWh. The bearings thus paid for themselves in two or three years, and at the end of eight years the wear was found to be negligible.

Mr. E. H. Edwardes (South Lancashire Transport Co.) pointed out certain difficulties which he suggested that manufacturers should endeavour to overcome, especially in lubrication, and expressed satisfaction that at last the bearing manufacturers were realising that what was suitable for a tramcar or a petrol bus was not suitable for a trolley bus, adding that the vibration sometimes found on trolley buses was often due to the bearings. Mr. G. F. Sinclair (rolling stock engineer, London Transport) remarked that on bogie trucks the roller bearing had a serious rival in the modern sleeve-bearing axle box. He did not think that ball bearings incorporated in trolley wheels had advantages over sleeve bearings. The application of roller bearings to tramcar motors, however, had proved an advantage in maintenance. In trolley-bus design with rheostatic braking or regenerative control special angular contact bearings were necessary. Mr. C. A. Hopkins (general manager, Sunderland) said that with the original roller bearings installed at Wigan, ordinary vaseline was used for lubrication, and he had since continued to use it with every satisfaction. Mr. C. Y. Knight (Morgan Crucible Co., Ltd.) asked if there had been trouble with ball or roller bearings due to electrical defects arising from a "grounded" motor. Mr. A. A. Jackson (general manager, St. Helens) complimented the bearing manufacturers on the valuable research work they had carried out. Mr. W. Vincent Edwards (Hastings and District Electric Tramways Co.) said he used graphite grease to lubricate the trolley heads, the grease being thrown centrifugally on to the trolley wire.

Mr. A. E. Grimsdale (Metropolitan Vickers Electrical Co., Ltd.) said there were dangers in over-packing bearings with grease, and commented on the difficulty of knowing how much grease remained in a bearing after a time. In this connection he suggested the use of a doctor's stethoscope with a small drum on the end which would magnify any noises in the bearing due to wear or other causes. Mr. R. S. Pilcher (general manager, Manchester) also commented on the savings to be made in current consumption from the use of ball and roller bearings, but added that in Edinburgh equally satisfactory savings had been made on routes on which ball and roller bearings were not being used as the result of intensive training of the drivers. He urged manufacturers to take up the conversion of old rolling stock. He understood that the cost of converting a single-truck tramcar was about £80.

The author, in reply, suggested that it was unfair to blame the bearing manufacturer for troubles that occurred after the machine manufacturer had made use of the bearing in a manner over which the bearing maker had no control.

The annual dinner was held in the evening.

Policy for the Transport Undertaking

On the second day of the Conference two papers were presented and discussed together, *viz.*, "Notes on the Operation of Three Types of Transport in a Seaside Town," by Mr. Ben England (general manager, Southend); and "Modernising a Tramways Undertaking—and the Result," by Mr. C. A. Hopkins (general manager, Sunderland).

The discussion was long and did not deal with technical matters. Questions of policy, having regard to the prevailing conditions, predominated, and in that respect the views expressed may be crystallised by saying that not only was it now appreciated by road passenger transport managers that the particular conditions of their respective areas must be considered as a special case, but the conditions of individual routes must also be taken into account. We seem now to have passed from the stage when even municipal councillors posed as out and out advocates of any one form of road passenger transport.

At the same time extensions of existing tramways are taking place, or are contemplated, in certain towns by reason of the special conditions existing locally. On the other hand, apart from the large busy cities, the feeling is growing that when the time comes for the reconstruction of track and the replacement of old rolling stock, tramways should be abandoned, probably in favour of trolley buses. The view was also expressed that tramways should not be scrapped until the outstanding debt had been paid off, but here, again, some managers held the view that even an outstanding debt should not necessarily be a reason for running an obsolete system. The obvious point was made that steps should be taken to liquidate such debt at a quicker rate, as was being done, for example, in Belfast, where the Ministry of Home Affairs had recently sanctioned a loan of £120,000 for fifty new tramcars on condition that the Corporation undertook to complete the liquidation of all sums outstanding on the tramways account by September 30th, 1944.

Mr. R. S. Pilcher, of Manchester, said the impression given by Mr. Hopkins's paper, that if the tramways were kept up to date there would be no need for buses, was a dangerous one to accept as a general policy. The great trouble was that municipal operators were being surrounded by company bus operators who ran past the termini of the municipal tramways, and the protection given to the tramways by the Commissioners in the matter of fares did not prevent the tramway revenue going down.

The high price charged at Southend for traction current, *viz.*, 1d. per kWh for tramways and 0.78d. per kWh for trolley buses, was commented on during the discussion, and lower summer charges were advocated. Mr. England intimated that the matter was being brought before the Electricity Committee.

Correspondence

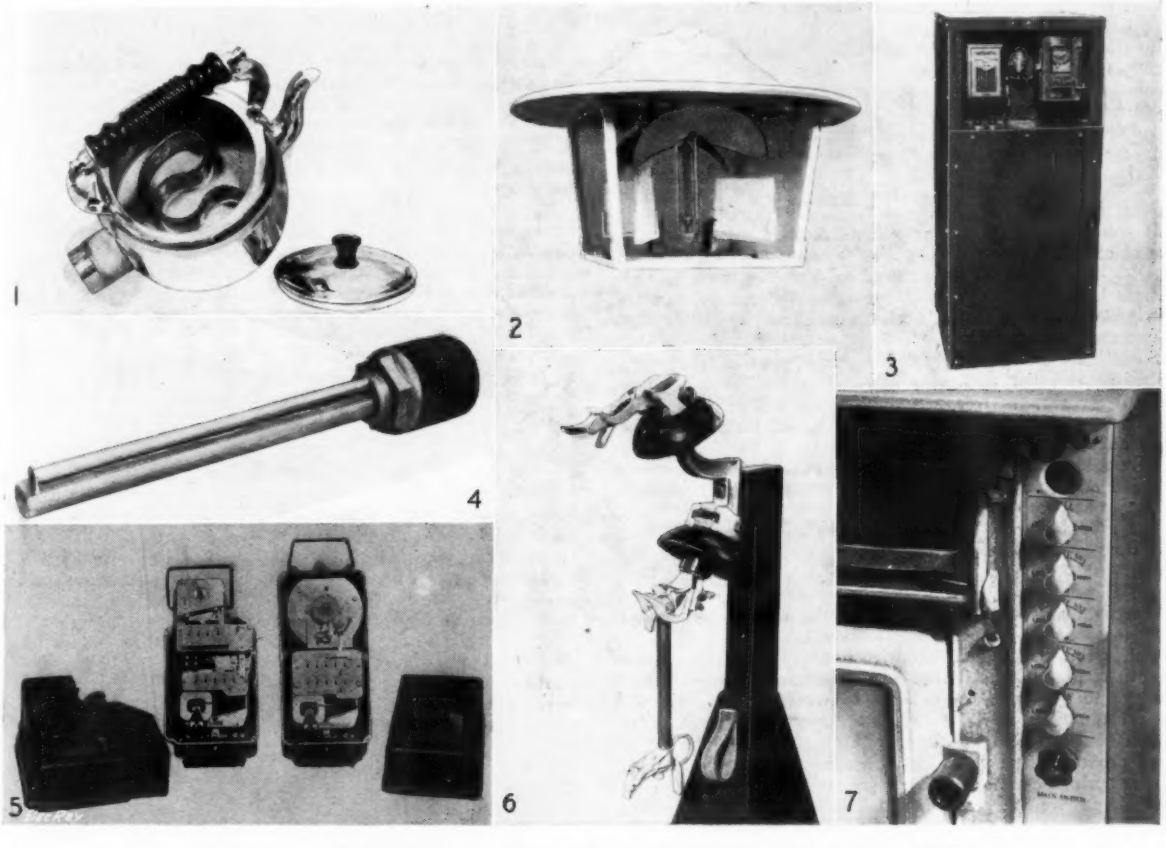
Correspondents should forward their communications as early as possible. No letter can be published unless we have the writer's name and address in our possession

Institution Membership

Referring to your leading article dealing with the Institution of Electrical Engineers, I have often tried to find a solution to the problem of obtaining a position of responsibility to qualify for the grade of Associate after one passes the examination, as all employers seem to require an A.M.I.E.E. or equivalent to fill the responsible positions.

I have asked numerous people in the electrical world this question, but still am no nearer a satisfactory explanation. I do not consider it fair to the rising generation who wish to seek promotion in what are very difficult times, so perhaps one of your readers could supply a suitable answer.

Bryanston, Dorset, *May 28th.* R. W. RAPSON.



Some of the Exhibits at the I.M.E.A. Exhibition (See page 772)

1. Shaped element in a Bulpitt quick-boiling kettle. 2. Siemens street-lighting fitting for gaseous discharge lamps (two panels removed). 3. Strowger remote-control transmitter for street lighting. 4. "Heatrae" immerser with "outside" thermostat. 5. Two-rate prepayment meter with change-rate compound and two-rate quarterly meter incorporating time switch (Venner). 6. "J. & P." overhead line switch-fuse (open) with automatic release. 7. Main switch, kettle plug and pilot light embodied in the structure of an "Xcel" cooker

Main Switch Control

I have no doubt that Mr. C. E. Gray will realise that correspondents will hesitate to give an answer to his question, since supply authorities have extremely wide powers, many bylaws, and the final word upon all such matters. The best advice is to comply with their wishes and straightway forget it. N. S. BYERS.

Warrington, *May 22nd.*

Radiant Electric Fires

In reply to the question put by "Inquirer" in your issue of May 18th, I believe that a Mr. Wilkinson, then the chief supply engineer of the St. Marylebone municipal undertaking, was the designer of the first electrical portable platform cooker which contained a nickel-chrome spiral heating element embedded in a semi-circular groove impressed in a vitreous porcelain platform. This was marketed by Messrs. Siemens in 1909.

My late brother, Robert Fifer, one of the founders of the "old" Concordia Electric Wire Co., Ltd., actually obtained the agency rights for nickel-chrome wires and tapes from the manufacturers, the Driver-Harris Wire Co., U.S.A. This wire was put on the market as "Concordin" H.R. wire and tape, and was actually used by the pioneers of radiant electrical heating and cooking apparatus in this country and on the Continent. S. FIFER.

London, N.16, *May 23rd.*

What is Ohm's Law?

I have just seen your issue of May 18th, and read Mr. H. M. Sayers's letter and your editorial note on this subject. It may be of interest to some of your readers to know that this same question cropped up over twenty years ago in the discussion on a paper entitled "The Characteristics of Insulation Resistance," by Mr. S. Evershed, read before the I.E.E. in November, 1913.

Prof. Silvanus Thompson, who opened the discussion, concluded his remarks with the following statement: "There is one important criticism I should like to make. I must protest most emphatically against the notion that there are any substances which do not obey Ohm's law. Ohm's law is true in all circumstances for every kind of conductor, or insulator, or current, or anything else. It depends entirely on the definition of 'resistance.' I do not know any way of ascertaining the resistance of a body except by passing a current through it; the name 'resistance' is given to the ratio between the electromotive force that is supplied and the current which results. That is Maxwell's definition. What Mr. Evershed undoubtedly meant, and what these people mean who say that something does not obey Ohm's law, is that the resistance is not constant. . . . I do not know of a single thing that does not obey Ohm's law. Not even in the voltaic arc is Ohm's law violated."

Sir R. T. Glazebrook subsequently took up the cudgels in the correspondence columns of one of your contemporaries, contending that Prof. Thompson was incorrect in this statement of Ohm's law, resulting in a lengthy discussion.

Welling, Kent, *May 27th.* J. F. PERRIN.

I can hardly resist pointing out that the letter of Mr. H. M. Sayers on this subject in your issue of May 25th gives additional point to the remarks I ventured to make in your

issue of May 18th. You, Sir, stick to the original meaning of Ohm's law—as laid down in the "Dictionary of Physics." This distinctly states that under constant physical conditions the ratio e.m.f. to current is constant, and this ratio is a measure of a property of the conductor known as resistance.

The same authority further states, as I pointed out in my previous letter, that this is the property in virtue of which electrical energy is turned *directly* into heat as the result of the passage of electricity through the conductor. Mr. Sayers, on the other hand, insists that Ohm's law is merely the statement that "the current in a circuit is the quotient of the e.m.f. acting round that circuit and the 'resistance' of the circuit"—whatever the physical conditions. But he also says that "for any bit of the circuit—this e.m.f. is the voltage drop *only* when that bit is *pure resistance*."

So Ohm's law is not quite so simple! And may I ask Mr. Sayers what is *pure resistance*? Is it not the resistance of a conductor which conforms to Ohm's law—as you define it, there being many conductors which do *not*? And are you not doing what you can to satisfy Mr. Sayers's first plaintive appeal—"please help us to squash inexact language"?

Eltham, *May 28th*. R. A. WEST, A.M.I.E.E.

The Handicap of High Charges

It seems extraordinary that, in all matters relating to the use of electric cookers, whether it be convention or meeting, articles or correspondence in your journal, the same accusation is levelled at the average housewife—her seemingly incorrigible ignorance in maintaining an apathetic attitude towards that type of cooker.

Sometimes the initial cost and installation of that very necessary piece of apparatus has been blamed for her preference for the gas cooker, which is often decried as being inefficient and unclean; but no amount of theory, coupled with an equally confounding two-part tariff, put forward by supply authorities' salesmen will shake that preference, unless positive and practical proof can be given that the electric cooker is as *cheap* to operate.

The manufacturers have done their part admirably, filling the show-rooms with every conceivable contrivance for the home, but the housewife's first thought is, "I wonder how much it would cost to run that." In short, it is the price of energy that compels the lady to walk on, and be content with her existing "inefficient" cooker.

Unless these prosperous electricity supply authorities abandon their high-handed policy of "take it or leave it," and see eye to eye with the persons to whom they would sell their commodity, I fail to see how they can hope to alter and combat the "gas-mindedness" now prevalent, and transfer a profitable load on to their own mains. We see housing estates springing up everywhere, gas points in every room (of course), gas works extended, and a London suburb is having another gas-holder built, to cope with the increasing demand, but electric heating is too often still considered a luxury by the ordinary householder.

I very much desire to have electric cooking and heating, but as there is no provision for these "luxuries," I shall have to see tiles, parquet flooring and tongued and grooved boards torn up and points put in (at my expense); but I am wondering whether, when my quarter's bill arrives, I shall say to myself, "Was it worth it?" L. C. FORD.

London, N.W.9, *May 23rd*.

Consciousness After Electric Shock

In reference to your correspondent's query under this heading in your issue of March 23rd, I give below my own experience.

I received an electric shock of perhaps a minute's duration in consequence of the framework of the starting switch of a rotary convertor becoming alive while operating. This frame was not earthed; the voltage was 560 a.c. I was holding a polished steel lever handle in my right hand and my left hand was gripping a grey painted iron pillar of the building steelwork.

My first sensation was that my heart was throbbing at a tremendous rate and I fully realised I was receiving electric shocks, but could not free myself. I reasoned I must call for help; I attempted what I thought a loud shriek, but this resulted, I was told later, in only a faint moan. Then I lost consciousness and all was peace—perfect peace. I came to immediately the power was switched off and sat down limp and exhausted. I was up again investigating the cause of the accident after about ten minutes. H. ALI JAN,

Asst. Trans. Supt. (Distribution),

Lonavla, India, *May 4th*. G.I.P. Railway Electrification.

An Installation Query

In the course of my contracting work I have recently come across a service main from a single-phase two-wire 200-V system, which is not at present earthed. The potential difference between the negative and earth (with fuses out) was 123 V and between the positive and earth 80 V. What attitude should be adopted towards the earthing of such appliances as fires, table lamps and irons? Correct wiring will not obviate the danger of shock. It seems foolish to provide three-pin switch plugs and three-core flex under such conditions. Also what explanation should be given to a semi-technical customer who, in checking up to see that his switch plugs are correctly wired, obtains a glow on his test lamp between the plug and the lead sheathing when his switch is off. With such a system of distribution surely both incoming conductors should be fused by the undertaking. G. R. JOHNSON.

London, S.E.1, *May 18th*.

A Diesel-electric Passenger Vessel

THE newest passenger vessel for the West of Scotland service of Messrs. David MacBrayne (1928), Ltd., is the twin-screw Diesel-electric vessel *Lochnevis*, which was launched on May 15th from the builders' yard at Dumbarton.

The complete electric propulsion gear has been supplied by the General Electric Co., Ltd. Each propeller is coupled to a separately excited shunt wound "Witton" motor rated at 525 b.h.p. at 400 r.p.m., supplied with d.c. at 500 V on the three-wire system from two 425-kW 500-r.p.m. compound-wound G.E.C. generators, each directly coupled to a Davey-Paxman Diesel engine. An auxiliary supply for excitation and general service is given at 230 V d.c. by two 48-kW 500-r.p.m. compound-wound self-excited generators, each directly coupled to one of the main engines; a 50-kW generator coupled to its own engine is provided as a standby, the three auxiliary generators being arranged to run in parallel.

Motor speed control can be obtained either direct from the navigating bridge or from the engine room in answer to bridge telegraph signals.

Anti-stalling and under-speed devices provide for protection against overloads on the engines or their failure from any cause. The latter is a patented feature which ensures that if one generator or engine fails for any reason the vessel will continue as a twin-screw ship without interruption of power, both motors being transferred automatically to the other generator. Complete electrical protection against overloads and earth leakage is also incorporated. Means are provided for the mechanical closing of the various field contactors, and complete emergency control in the event of failure of electrical operation.

The Diesel-electric vessel "Lochnevis"

Among the other equipment supplied by the G.E.C. are two hot presses, one 4 ft. and one 3 ft., and four water boilers, three 3-gal. and one 15-gal., for the galley. In addition to the larger equipment mentioned in these notes G.E.C. bell indicators, fuse boards, switches, and lighting fittings are employed in the vessel.

Business and Industrial Notes

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations, and Failures

A Combustion Engineering Merger

By order of the Court meetings of Combustion Engineering, Ltd., Combustion Steam Generator, Ltd., the Detrick Arch Co., International Combustion, Ltd., Mining & Industrial Equipment, Ltd., and the Underfeed Stoker Co. are to be held on June 8th to consider a scheme of arrangement which provides for the formation of a new company with a capital of £501,698, divided into 150,000 6 per cent. cumulative preference shares of £1 each and 351,698 ordinary £1 shares. International Combustion, Ltd., will receive 113,682 ordinary shares and the whole of the preference capital of the new company credited as fully paid. Mining & Industrial Equipment, Ltd., will be allotted one new ordinary share for every fifteen of its own ordinary shares, and the other companies will receive ordinary shares in the new company on a share-for-share basis.

Trolley Buses for Australia

The first A.E.C.-English Electric "Q" type trolley bus to be put into service in the Commonwealth has recently been shipped to Australia. It was accompanied by two "Q" type trolley bus chassis which are to be fitted with bodies when they reach Sydney. The chassis of the three trolley buses are of the two-axle pattern with a wheelbase of 15 ft. 10 in. and a

An A.E.C.-English Electric trolley bus which has been shipped to Australia

turning circle of 53 ft. on the off side and 59 ft. on the near side. The power unit is a specially designed English Electric "EE405" 80 h.p. 500-V self-ventilated motor. It is situated in the middle of the chassis, and is mounted cantilever fashion on the off side of the frame. The contactors are mounted in weatherproof and splashproof cases and are also fixed to the side of the chassis. Resistances are of the rustless, jointless, unbreakable, grid type, the master controller, together with the reverser, trolley skate change-over switch, terminal board and stoplight switch, being mounted in one case on the chassis under the driver's seat. The motor drives directly on to the fully floating rear axle by means of a single tubular propeller-shaft fitted with large Spicer couplings. Brakes are of the Lockhead air-assisted pattern, compressed air being provided by a ¾-h.p. motor. The body of the complete vehicle, built by Park Royal Coachworks, Ltd., has accommodation for sixty-three passengers.

Works Visit

On May 24th forty students of the Birmingham Central Technical College, accompanied by Mr. C. H. Partridge, paid a visit to the works of Messrs. Veritys, Ltd., Aston. The party spent an interesting time in the various shops and were afterwards entertained to tea.

Exhibition of Art in Industry

An exhibition of contemporary British art in industry is to be held by the Royal Academy of Arts in collaboration with the Royal Society of Arts at Burlington House from January to March, 1935. The exhibition will be divided into eleven classes of articles, and advisory committees have been formed for each section to make a preliminary selection of works submitted. The final selection is reserved to the Executive Committee composed of members of the Royal Academy and the Royal Society of Arts. In the selection of exhibits primary importance will be attached to decorative value, based on originality of design, attractive finish and suitability of material and method of manufacture. The sections of electrical interest are those covering glassware and domestic equipment; the former will include illuminating glassware, and the secretary is Mr. G. Marchand, Glass Manufacturers' Federation, 13, Southampton Street, W.C., to whom application should be made for the date by which works or designs must be submitted. The domestic equipment section will include electric fires, lighting and other fittings and appliances, and domestic appliances. The advisory committee includes Mr. A. C. Cramb (E.D.A.) and Mr. C. Rodgers (B.E.A.M.A.), and particulars relating to the electrical section can be obtained from the latter at the B.E.A.M.A. offices, 36, Kingsway, W.C. Full particulars of the exhibition and general conditions can be obtained from the hon. organising secretary, Royal Academy Exhibition of British Art in Industry, 1935, Royal Academy of Arts, Piccadilly, W.

The Battersea Power Station

We have received from the London Power Co., Ltd., a beautifully produced booklet describing the Battersea power station. This contains historical notes showing the events which led to the erection of the station and detailed particulars of its construction and of the plant installed. It is profusely illustrated with some excellent views of the various sections of the station, while portraits of Sir Francis Fladgate (chairman), Dr. S. L. Pearce (engineer-in-chief), and Mr. W. A. Pearman, general manager and secretary, are included. A list of the contractors responsible for the civil, mechanical and electrical engineering work and the manufacture of the plant is given.

The Transport of Large Machinery

An exceptional transport feat was begun by the L.M.S. Railway last week-end when a special train conveying the first of three 45-ton rotors for the Galloway power station at Tongland (Kirkcudbrightshire) set out from Stafford. Each rotor will take a fortnight on the 220-mile rail journey from Stafford to Castle Douglas, for owing to the dimensions of the load, which is 13 ft. 5¼ in. wide, the journey can be undertaken only on a Sunday with the opposite line blocked. Last Sunday the big load, which was carried in each case on a twenty-four-wheeler 120-ton wagon, reached Carnforth and will remain there until the final stage of the journey to Castle Douglas is undertaken next Sunday. Signal-posts, gateposts and fog-signalmen's huts will have to be dismantled at certain points *en route* to enable the special train to pass, while at Winsford (Cheshire) and at Clifton and Lowther (Westmorland) the lines will have to be slewed.

Electric Lamps for British North Borneo

The British Trade Commissioner at Singapore has forwarded to the Board of Trade a copy of Notifications published in the *Official Gazette* which provide that the general rate of duty on electric lamps imported into British North Borneo shall be increased from 10 per cent. to 25 per cent. *ad valorem*, the preferential rate remaining at 10 per cent. *ad valorem*. The Notifications also provide that electric lamps shall be added to the list of goods which, to qualify for entry at preferential rates of duty, must contain at least 50 per cent. of British Empire labour and/or material.

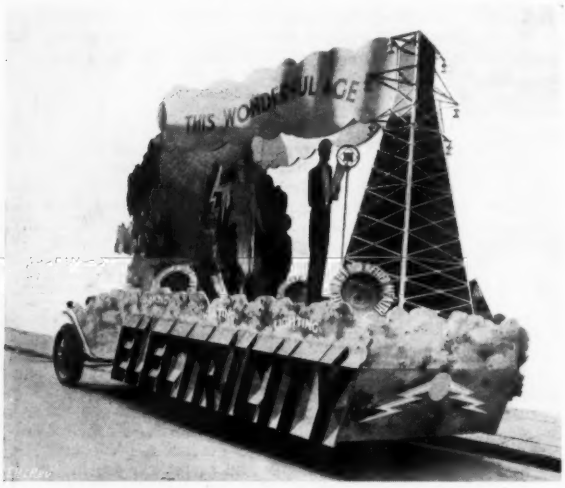
E.D.A. Activities

The window display illustrated in the June programme of the British Electrical Development Association has been specially designed to link up with the electric cooking cam-

A special E.D.A. cooking campaign display

paign. As will be seen from the accompanying illustration the display embraces three electric cookers, and the material for dressing the window includes a centrepiece, complete with

stallboard, three display signs, worded "Simpler," "Better," and "Cleaner," crêpe paper, and a set of six pictures reproduced from the booklet "This Wonderful Age," to which special attention is drawn in the programme. The greater part of the programme consists of a special local Press advertising supplement of six 8-in. double-column advertisements, which has been prepared in order to test the demand for a large variety of advertisements at a time when a peak in local Press advertising for cooking and water heating is to be desired.



The E.D.A. carnival car

Particulars of an E.D.A. poster, in three sizes, the summer number of "Electrical Housekeeping," and a price list of literature relating to cooking and water heating are also included.

The E.D.A. processional car for summer carnivals is now available for hire. As our illustration shows the tableau illustrates "The Gift of Electricity," while a modern note is introduced in the form of a cut-out announcer whose statements are to be seen emerging at each corner of the car. The equipment also includes a public address system controlled from the driver's cab. The cost of hiring the car for each carnival procession will be not more than £14 14s., and each member of the Association will be charged the same fee for the service irrespective of distance. As a result of the first announcement nearly thirty undertakings have already booked the car.

A Bank Lighting Installation

We are informed by the Edison Swan Electric Co., Ltd., that their engineers did not plan the lighting installation at the reconstructed Glyn Mills Bank as stated in our issue of May 11th. Dr. Oscar Faber, the consulting engineer, was responsible for the design, in collaboration with Lord Wolverton, the architects and the electrical contractors, Messrs. Drake & Gorham, Ltd. Some of the fittings were supplied by the Ediswan Company.

Social Events

Excellent support was accorded on May 24th to the third competition of the Wallasey and Birkenhead Electrical Trades' Golfing Society, played over the course of the Leasowe Golf Club. There were two trophies for competition, the Phillips' challenge bowl and the McIntosh tankard. The event took the form of a stroke competition, Mr. E. G. Pulford and Mr. G. A. S. Trace being the successful competitors.

On May 27th a party of change-of-frequency engineers on the North-East Coast were met by the local representatives of the electrical manufacturers and contractors at Durham City Golf Club. The first prize, a trophy presented jointly by the manufacturing and contracting firms, was won by Mr. N. Veale, of the Change-of-Frequency Department, Carliol House, Newcastle-on-Tyne; the second prize was won by Mr. A. Wright, of the same department, the third prize being awarded to Mr. Urwin Shaw, of Messrs. R. J. Shaw & Co. The afternoon was devoted to foursomes competitions, the winners being Messrs. J. Hopper and U. Shaw (first), H. Topps and B. Shaw (second), and L. Hutchinson and R. Gent (third). At the close of play the party adjourned to the Castle Hotel, Durham for dinner, during which Mr. Morley, on behalf of the manufacturing and contracting firms, presented the prizes. As a memento of the day's outing each playing member of the party was presented with a replica of the trophy.

Yarrow Boiler Contracts

Messrs. Peter Dixon & Son, Ltd., Grimsby, have placed an order with Yarrow & Co., Ltd., for new boiler plant, which includes three Yarrow land-type boilers. Each boiler is designed for an evaporation of 37,000/55,000 lb. per hour at a working pressure of 425 lb. per sq. in. superheated to 700 deg. F., in a Yarrow integral superheater. The plant also includes a new steel frame boilerhouse, coal-handling plant, overhead bunkers, feed pumps, de-aerating plant, &c. The boilers are fired by chain-grate stokers of the Underfeed Stoker Co.'s "L" type. The company has also received an order from the Pretoria City Council for two Yarrow land type water tube boilers, each to evaporate 80,000/100,000 lb. per hour at a working pressure of 365 lb. per sq. in. and a steam temperature of 690 deg. F. The contract includes the supply of chain-grate stokers by Babcock & Wilcox, Ltd.; Foster type economisers; Yarrow airheaters; fans and grit catchers by Davidson & Co.; feed pumps by G. & J. Weir, Ltd.; and the steel frame building for housing the boilers, turbines and switchgear, the latter being sublet to Dorman Long & Co., Ltd. The whole of the designs and the work in this country are being carried through under the supervision of Messrs. Merz & McLellan, consulting engineers, and in South Africa by Mr. L. L. Horrell, the city electrical engineer. Another order received by the company is from the Burmah Oil Co., Ltd., for seven land-type water tube boilers, each to evaporate 17,000 lb. per hour at a working pressure of 220 lb. per sq. in. and steam temperature of 555 deg. F.

The Bath and West Show, Oxford

At the Bath and West Show, which is being held at Oxford during the current week, Messrs. Petters, Ltd., are showing a representative selection of their oil engines and combination sets specially suitable for agricultural purposes. The engines include oil and petrol plant and atomic Diesel engines from 5 b.h.p. upwards. There are also automatic electric lighting sets of 4,000-W and 1,000-W capacity and examples of pumping sets.

A comprehensive display of power, heating, lighting and other applications on the farm has been arranged on stand 272. The stand itself is a portable structure, supplied by E.D.A. and specially designed for the effective demonstration of electricity on the farm. This is the first occasion upon which it has been used, and as it will appear at agricultural shows in various parts of the country it will become a familiar landmark to the agricultural community. The Shropshire, Worcestershire and Staffordshire Electric Power Co., the Oxford Electricity Supply Department, the Oxford Electric Co., and the Wessex Electricity Co., have co-operated with E.D.A. in the electrical display. The S.W. and S. Co. has been responsible for the exhibits dealing with electrical applications to poultry, dairy and general farming; demonstrations of electric water heating, cooking and commercial baking, occupying one entire side of the stand, have been arranged by the City of Oxford; on the other side the Wessex Co. shows electric fires and small appliances suitable for the farmhouse, while the Oxford Co. displays washing machinery and refrigerators. The General Electric Co., Ltd., also exhibits various appliances. At the far end of the stand is the inquiry bureau of E.D.A.

Trade Announcements

The St. James's Electrical Co., Ltd., has removed to 53, Victoria Street, S.W. (Telephone: Victoria 6893.)

The Sinterae Illuminating Co. has removed to Avenue Chambers, Vernon Place, Southampton Row, W.C. (Telephone: Holborn 7072 and 5952).

The Streatham branch of Superlamp, Ltd., has been removed to 10, Sunnyhill Road, Streatham, S.W., and the company's trade counter has been transferred to 91, Tabernacle Street, E.C.

Henley Wiring in a Concert Hall

The Leas Cliff Hall at Folkestone, built on the face of the cliff at a cost of £80,000, has recently been rewired by the Folkestone Electricity Supply Co., with Henley's 2,500-

Leas Cliff Hall, Folkestone

megohm grade wires throughout, and the installation has been brought up to date by the inclusion of public address equipment, dimmers, modern stage lighting and coloured spot lighting, each of the spot lights being separately controlled and capable of independent dimming. The whole lighting equipment and effects in the Concert Hall are on modern lines. The elaborate fittings have been left in position, but the original fittings in the foyer, members' subscription room and silence

room have been replaced by Ediswan "Ace" type fittings. In all 588 lights are employed.

New Municipal Showrooms

At its last meeting the Dundee Corporation Electricity Committee adopted a recommendation for the provision of a showroom for the purpose of introducing hire-purchase for cookers, wash-boilers, water heaters, radiators, and the hire-purchase of wiring. The Committee decided against direct sales of electrical appliances. In a statement the Convener said the Gas Department put in fires without any charge for them, and that Department was underselling the Electricity Department. The Convener added that the proposals put forward were exactly as had been agreed upon at a meeting with the contractors. Hire purchase of cookers would be on the basis of 25 per cent. down and the rest spread over three years by monthly payments. For hire a certain amount would be paid to cover the upkeep. The initial cost of the showroom was estimated at £4,500 and the annual running costs £1,700.

The new showrooms of Dover Corporation Electricity Department were formally opened on May 25th by the Mayor (Councillor F. H. Morecroft), who said that the electricity works were started in 1895, but during the past few years the demand for electricity and the number of customers had greatly increased, which meant increased staff and further accommodation. In 1924 the number of consumers was 4,090; to-day it was 7,600. Accommodation had been provided in the new premises for the Committee and officials, and on the ground floor there were inquiry and general offices and a showroom. One room would be used for demonstration purposes and another was fitted for records. The showroom, designed on the most modern lines, was panelled in white Indian mahogany, relieved with green and black walnut, and the staircase was constructed of Austrian oak. The whole building was heated by thermostatically controlled tubular heaters.

The new showrooms of the Gillingham Corporation Electricity Department will be inaugurated by the Mayor (Ald. S. O. Summers) on June 9th.

A sub-committee of the Cardiff City Council has recommended that the Hayes Fish Market shall be handed over to the Electricity Department for development as showrooms, &c. The Electricity Committee will acquire the property from the Markets and Properties Committee for a sum of £22,500.

Prices of Materials

Messrs. James & Shakespeare report, May 30th: Copper bars (best selected), sheet and rod, no charge. Copper (electrolytic) sheets, £36 to £36 5s., 5s. to 10s. inc. English pig lead, £12 10s., 5s. inc.

Messrs. Edward Till & Co. report, May 30th: Indiarubber, Para fine, 5½d., ½d. dec.

The German Cable Industry

It is reported that since the beginning of the current year activity in the German cable and conductor industries has increased by 60 per cent. Most of the works are well supplied with raw materials, and as further requirements are expected from public authorities and the Post Office, and as a result of the extension of electricity supply in country districts it is hoped that the industry will receive an increase in orders. The export trade is stated to be depressed with no immediate prospect of an improvement. The cause of the inadequate exports is ascribed to the extension of the productive capacity of foreign works, especially in England and Holland.

"Modern Insulators"

In the article bearing this title published in our issue of May 11th reference was made to a "slip-ring" insulator. This was itself a slip, the correct term being "spring-ring."

Proposed Philips Factory for India

It is announced that the Philips' Gloielampenfabrieken, of Eindhoven, intends to establish a lamp factory in India as a result of the high import duties. Prof. Hesselink, the technical advisor, is already in Calcutta, where he is making the necessary preparations for the new factory.

A Convention Souvenir

The Whitecross Co., Ltd., of Warrington, has sent us a notepad in a neat black limp-leather cover which can be conveniently slipped into the waistcoat pocket. These were distributed to delegates this week at the I.M.E.A. Convention.

For Sale

The Northampton Electric Light & Power Co., Ltd., has for sale three-phase, 50-cycle transformers.

(See our classified advertisements.)

Recent Contracts

The English Electric Co., Ltd., has recently received an order for the hydraulic generating plant for the three power stations comprising the second stage of the Galloway hydro-electric scheme. The contract comprises two vertical reaction water turbines and generators each with a normal output of 14,800 h.p. for Kendoon power station and four similar sets each with a normal output of 8,500 h.p., two of which will be installed in Earlstoun power station and two in Carsfad power station. The two last-named stations will be arranged so that they can be operated by supervisory control from Glenlee. The contract, which represents a total value of over £200,000, follows upon those for the equipment for Tongland and Glenlee power stations, now being executed by the same company. The Galloway hydro-electric scheme has been undertaken by the Galloway Water Power Co. for supplying power to the grid, the consulting engineers for the plant and equipment being Messrs. Merz and McLellan. When completed it will have a total normal capacity of 102,000 kW.

The E.M.B. Co., Ltd., has received orders from the Glasgow Transport Department for 125 sets of complete air brake equipment and 115 electro-magnetic brakes in connection with the Department's scheme for reconditioning 125 tramcars. Both of these are repeat orders.

A Vacuum Cleaner Campaign

In order to stimulate trade sales of electric vacuum cleaners, British Electric Domestic Appliances, Ltd., recently offered cash prizes to the authorised dealers of "Mary Ann" cleaners who sold the greatest numbers of these machines in April. The

Mr. S. F. Sheridan (right), presenting Mr. A. W. Flay with the first prize in the company's vacuum cleaner competition

first prize of £10 was won by the Edgware Hardware Stores, 91, High Street, Edgware, the second by Messrs. Musgrove & Johnson, of Southampton, and the third by Messrs. Bickers, Ltd., of Dewsbury. The accompanying picture shows Mr. S. F. Sheridan, managing director of the company, presenting Mr. A. W. Flay, proprietor of the Edgware Hardware Stores, with the first prize.

Amplifiers at the Runnymede Pageant

One of the most elaborate amplifying equipments in the country will be the public address installation to be used at the Runnymede pageant, the contract for which has just been secured by Philips Industrial. Over 4,000 performers, mounted and foot, will be taking part in the pageant, and since only the prologue and the epilogue will be spoken the principal use of the amplifiers will be to transmit the pageant master's instructions to the players, as well as to announce the entrance cues in the dressing tents and horse lines. This has presented an intricate technical problem, for the loud speakers have to be adjusted so that the pageant master's voice shall be heard by the performers but inaudible to the spectators. The difficulty has been overcome by the company's engineers by the use of a special arrangement of screened microphones and concealed loud speakers.

New Catalogues and Lists

L. G. Hawkins & Co., Ltd., 30/35, Drury Lane, Kingsway, W.C.2.—Coloured broadsheet on glassware and shades.

Leda Electric, Ltd., Oldham Road, Miles Platting, Manchester.—Leaflet dealing with a two-hole portable ice-cream conservator and combined ice-cream freezers and storage cabinets.

The Household Appliance Co., 85, Cromwell Road, S.W.7.—Particulars of the "Anyvac" washer for fitting to vacuum cleaners.

Service Equipment Co., Ltd., 99, Albion Street, Leeds.—A catalogue of "S. E. Gilbert" precision fans.

Harland & Wolff, Ltd., North Woolwich, E.16.—A leaflet on the Murphy patent swivel.

Hotpoint Electric Appliance Co., Ltd., 24, Newman Street, Oxford Street, W.1.—A number of window stickers for use with window shows of Hotpoint cookers, and a leaflet dealing with the "Bandolero" fan.

Marconiphone Co., Ltd., 210-212, Tottenham Court Road, W.1.—A folder dealing with public address equipment.

G. O'Kill & Co., 3, Arundel Street, W.C.2.—A booklet on "Braby" pressed-steel low-temperature wall and ceiling panels and strip heaters.

Rotax, Ltd., 319, Regent Street, W.1.—A 31-page art catalogue of Newton Mercury arc oxide cathode rectifiers.

A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—A pamphlet on the interlock feeder-protective system.

Electric Furnace Co., Ltd., 17, Victoria Street, S.W.1.—A booklet on the progress of electric furnaces.

Siemens Electric Lamps & Supplies, Ltd., 38-39, Upper Thames Street, E.C.4.—A new fan catalogue.

Sun Electrical Co., Ltd., 118/120, Charing Cross Road, W.C.2.—A catalogue of electric fans.

Smith's English Clocks, Ltd., 179/185, Gt. Portland Street, W.1.—Four window bills on synchronous clocks.

G. Becker, Ltd., Ampère Works, Wembley.—Leaflets on junction boxes, switches and switchplugs.

Celglo Luminous Signs, 154, Clapham Park Road, S.W.4.—Particulars of "Celglo" luminous switch indicators.

Imperial Lighting Co., 2, Pocock Street, Blackfriars, S.E.1.—A catalogue of "Fairyland" lighting fittings.

British Insulated Cables, Ltd., Prescot.—Leaflets on "Bulldog" black adhesive tape, "Coraline" soldering paste and "Resinkor" solder.

Marconiphone Co., Ltd., 210/212, Tottenham Court Road, W.1.—A series of nine showcards advertising the company's radio equipment.

A. P. Lundberg & Sons, Ltd., 477/489, Liverpool Road, Holloway, N.7.—Leaflet on the "Union" combined b.c. adaptor and two-pin plug.

Smith's English Clocks, Ltd., Cricklewood Works, N.W.2.—A pamphlet on a synchronous electric bell controller.

A. J. Coleman & Co., 37/41, The Arcade, Northampton.—A 72-page electrical catalogue.

Private Arrangements

L. W. Seager, trading as Seagar Radio, 139a, Abergele Road, Colwyn Bay.—At a recent meeting of creditors, a statement of affairs was presented showing liabilities of £347 due to unsecured creditors. The net assets were £126, leaving a deficiency of £221. It was decided that the deed of assignment already executed in favour of Mr. A. E. Hughes should be confirmed, whilst a committee of three of the creditors was also appointed.

H. A. White, 10, Priory Road, Knowle, Bristol, formerly at 38/40, Victoria Street, Bristol, wireless dealer, &c.—The creditors were called together on May 23rd, at 28, Baldwin Street, Bristol, when the statement of affairs showed liabilities of £1,240 and net assets of £999. It was stated by the accountants that with regard to the fully secured creditors the valuation placed on the properties might prove somewhat excessive and some difficulty might be experienced in disposing of them. It was decided that a deed of assignment should be executed to Mr. Arthur Collins, whilst a committee of three of the creditors was also appointed.

Bankruptcy Proceedings

W. Marcroft and **J. Millington,** trading as J. Millington & Co., 158, Derby Street, Bolton, wireless manufacturers.—The first meeting of creditors herein was held recently at the Official Receiver's offices, Byrom Street, Manchester. The joint liabilities were stated to amount to £1,322, and there were assets of £1,082, leaving a deficiency of £230. The debtors commenced trading together at Hulme Street in June, 1933, with a capital of £600. The takings averaged £20 a week. The creditors appointed Mr. J. F. Warburton, Lloyd Street, Manchester, as trustee of the estate.

W. S. Fray, trading as R. E. Warren, 1, Albert Road, Torquay, electrician.—The public examination was resumed at Exeter recently. The statement of affairs showed ranking liabilities of £601, and assets of £76, leaving a deficiency of £525. Debtor attributed his failure to ill-health, loss on motor vehicles, and insufficient profit on contract work. The examination was closed.

C. E. Wooton, 10, Cemmaes Terrace, Collett Road, and 109, Marlowes, Hemel Hempstead, Herts, electrical engineer.—This debtor's application for discharge was heard at St. Albans recently. It was reported that the receiving order was made on March 2nd last year. Debtor stated that he was at present employed in an electrical business owned by his wife. The discharge was granted, subject to six months' suspension.

E. S. Mellor, 15, Cole Street, Scunthorpe, Lincs, electrical engineer.—The receiving order herein was made on the debtor's own petition and at the first meeting of creditors, held recently, at the Official Receiver's office, St. Mary's Chambers, Great Grimsby, the case, being a summary one, was left in the hands of the Official Receiver as trustee. The statement of affairs showed liabilities of £389 and assets of £103.

A. G. Overton, 75a, Pasture Street, Great Grimsby, lately "Beverley," Tetney Lane, Holton-le-Clay, Lincs, electrical engineer.—The receiving order herein was made recently on the debtor's own petition, and at the first meeting of the creditors, held at the Official Receiver's office, St. Mary's Chambers, Great Grimsby, the statement of affairs showed liabilities of £169, against assets of £53, leaving a deficiency of £116. The case, being a summary one, was left in the hands of the Official Receiver as trustee.

H. Barker (Broadway Radio Stores), radio dealer, 848, Manchester Road, Bradford.—Public examination June 26th at the County Court, Bradford.

H. A. Langlois, electrical contractor, 2, Atlas Place, Cardiff, and at Leicester.—Last day for receiving proofs for dividend June 6th. Trustee, Mr. L. S. Findlay, 35, Windsor Place, Cardiff.

A. J. Harding, electrical engineer, 50-51, Broad Street, Hereford. Receiving order made May 18th on debtor's own petition.

G. H. Dye (Radio Electrical Service), electrical engineer, 3, St. Augustine's Street, Norwich.—Receiving order made May 22nd on debtor's own petition.

J. H. Peacock, wireless retailer, Cornmarket, Pontefract.—First meeting June 5th at 13, Burton Street, Wakefield. Public examination June 14th at the Court House, Wakefield.

R. B. Emerson, electrical engineer, 330, London Road, Westcliff-on-Sea.—Trustee, Mr. W. D. C. Todd, 3, Cannon Street, E.C., appointed May 19th.

Company Liquidations

Birka Regulator Co., Ltd.—Winding up voluntarily. Liquidator, Mr. A. A. Lough, 8, Fredericks Place, E.C.

Lotus Radio, Ltd.—Meetings June 7th at 3, Lord Street, Liverpool, to receive an account of the conduct of the liquidation during the year ended May 31st by the joint liquidators, Messrs. F. C. Marsh and W. T. Wood.

Electricity Supply

Lighting, Domestic, Power

Australia.—CO-ORDINATION IN NEW SOUTH WALES.—The New South Wales Government has decided to constitute an Electricity Advisory Committee under the Minister for Local Government (Mr. Spooner). Its work will be to advise the Minister upon all matters relating to co-ordination of electrical undertakings, and it will be the official link between the Government and the electrical industry. It will deal with problems relating to the generation, supply and use of electricity, as well as proposals for the better regulation of the manufacture, sale and use of electrical materials and appliances. There is no intention of interfering with the local control of undertakings.

Part of the extensive illuminations at Llandudno carried out with the aid of several thousand striplight lampholders supplied by Becantee Illuminations, Ltd.

Amersham.—SUPPLY TO COUNCIL HOUSES.—The Rural District Council has decided to provide electricity to all the Council houses not at present supplied, at an estimated cost of £1,300. Tenants will be charged an extra 3d. per week for a period of six years to cover the cost of installation.

Bexhill.—LOAN.—The Electricity Committee is seeking sanction to borrow £1,097 for works proposed to be carried out in connection with the change-over of supply.

Bradford.—NEW EQUIPMENT.—The Electricity Committee has approved a scheme for the extension of the Sunbridge Road sub-station, for general supply and traction purposes, at a total estimated cost of £15,655, inclusive of the price of the necessary cables. Mains extensions estimated to cost about £2,000 have also been approved.

Brighton.—MAINS EXTENSIONS.—The mains are to be extended at a cost of £2,145. The recent extension to Poynings is also to be connected with the Dyke Hotel at a cost of £910.

FLOOD-LIGHTING.—The Electricity Committee has arranged to spend £700 on special illuminations this year in various parts of the Borough, including floodlighting on one of the bathing beaches.

Chapel-en-le-Frith.—SUPPLY EXTENSIONS.—The Rural District Council has decided to offer no objection to the use of overhead lines by the Trent Valley & High Peak Electricity Co. for the supply of electricity between Charlesworth and Gamesley.

Chesterfield.—PROGRESS.—During the year ended March last the Electricity Department connected an additional 821 consumers, representing an additional demand of 2,538 kW. The total number of consumers now connected to the mains is 14,239, with an aggregate load of 33,055 kW. An additional 15 miles of mains were laid, raising the total to 268 miles. The total amount of electricity sold was 15,476,552 kWh, showing an increase of 22¾ per cent, a record for the undertaking. The average prices obtained were—lighting flat rate 3.52d., domestic all-in rate 0.82d., heating and cooking flat rate 0.74d., power 0.75d., traction 0.88d., and public lighting 0.95d., the average price obtained for the whole supply being 1.27d. per kWh. The net profit amounted to £9,022, and as the accumulated surplus, including reserve fund, at the end of March amounted to £56,770, or 11¼ per cent. of the aggregate capital, it has been decided to make reductions in the charges as from July. These reductions are as follows:—Lighting flat rate reduced to 3¼d. per kWh gross; fixed charge of the domestic combined rate reduced by 8 per cent.; large power consumers' maximum demand charge reduced by 5s. per kVA per annum; small power consumers' sliding scale reduced from 1¾d. and 1¼d. to 1½d. and 1¼d. per kWh; prepayment meter rents limited to a maximum of 1s. 8d. per meter per quarter. The borough electrical engineer responsible for these changes is Mr. D. H. Davies.

Clitheroe.—SUPPLY TO DOWNHAM.—One of the famous beauty spots of the North, the village of Downham, is to have a supply of electricity from Clitheroe. The squire, Mr. R. C. Assheton, is paying for the cables to be laid underground.

Croydon.—NEW CABLES.—The Electricity Committee is to lay cables in the Northward Road and Spa Hill districts at a

cost of £2,158, and other mains are to be extended at a cost of £4,751.

LOAN.—The Electricity Committee has obtained sanction to borrow £42,000, for the erection and equipment of a boiler house.

REDUCED CHARGES.—The Electricity Committee reports, with regard to the reduction of the flat rate charge from 6d. to 5½d., that the County of London Electric Supply Co., Ltd., intimates that it will now make a similar reduction in the flat rate charge in its Addington area.

Daventry.—OVERHEAD LINES.—The Northampton Electric Light & Power Co. is to erect h.p. and l.p. lines at Weedon Beck and Dodford with the consent of the Daventry Rural District Council.

Dover.—REDUCED CHARGES.—The Electricity Committee has recommended that the charge for electricity for heating and cooking shall be reduced from 1½d. to 1d. per kWh, and that consumers shall be allowed to use domestic apparatus on heating circuits.

HIRE-PURCHASE SCHEME.—The Electricity Committee has decided in favour of a hire-purchase scheme for cookers and other household devices, and the question of financing the scheme has been deferred until further details are available. The Committee had previously decided not to undertake hire-purchase business, and the present proposal is to offer hire-purchase terms to consumers wishing to buy articles stocked in the showroom of the value of £3 and upwards.

Dundee.—ADVERTISING ELECTRICITY.—A campaign costing £10,000 for stimulating the sale of electricity in Dundee is to be undertaken by the Electricity Department. Showrooms, with displays of the latest electrical equipment, are to be acquired in the centre of the city, and the larger appliances will be hired out to consumers. The final details of the publicity scheme have been approved by the Electricity Committee and an assurance has been given by the convener that the local electrical traders have approved of it. A sub-committee which has considered the details of the scheme had decided against direct sales of electrical apparatus by the Corporation.

Elham.—EXTENSIONS.—The Folkestone Electricity Supply Co., Ltd., has informed the Rural District Council of its intention to give a supply of electricity to Ottinge and Elham, with a prospect of extensions to Lympne and Hawkinge. It is understood that the Air Ministry will revise its restrictions on the use of overhead lines at both these places, where there are aerodromes.

Glasgow.—REDUCED HIRING CHARGES.—The Electricity Committee has approved of the proposal of the manager to make substantial reductions in annual rentals for fires and water-heating equipment as from June 1st.

HIRING COOKERS AND WATER HEATERS.—In connection with the installation of electric cookers and water heaters the Electricity Committee has authorised the manager to carry out the installation of the necessary circuits at a charge of 20s. in each case—the hirers to be responsible for the carrying out of the necessary plumbing work for water heaters.

NEW MAINS.—The Electricity Committee has approved the laying of distributing mains at a cost of £14,078.

CONTROLLING FLOODLIGHTING.—The magistrates have agreed to recommend that a clause be inserted in the next appropriate Provisional Order promoted by the Corporation conferring powers on the Corporation to regulate and control the floodlighting of buildings in the city.

Glossop.—OPTION TO PURCHASE UNDERTAKING.—The Urban Electric Supply Co., Ltd., has submitted to the General Purposes Committee a statement of the reductions in the price of electricity which it is prepared to make in consideration of the Corporation waiving its option of purchase of the undertaking in 1935 and 1942. The town clerk has been directed to submit the alternative suggestions now mentioned as the basis of the terms under which the Corporation would be prepared to waive the option of purchase.

Herne Bay.—SUB-STATIONS.—The Herne Bay & District Electricity Supply Co., Ltd., is to erect sub-stations at Reculver Road, Beltinge, and Greenhill Road, Herne Bay.

Holmfirth.—METER RENTS DISCONTINUED.—The Electricity Committee has decided to abolish meter rentals as from April 1st, 1934.

Jarrow.—SUB-STATION.—The Newcastle-upon-Tyne Electric Supply Co., Ltd., is to erect a sub-station in North Street.

London.—BATTERSEA.—The Electricity Committee is to provide electricity services to 125 premises at a cost of £1,061.

DEPTFORD.—The Highways Committee recently decided to make improvements in the street-lighting and invited the South Metropolitan Gas Company and the London Electric Supply Corporation, Ltd., to submit schemes. At the last meeting of the Council it was recommended that the London Electric Supply Corporation should provide and maintain fifty-three "Osira" lamps at £8 15s. per lamp per annum. It was moved that the recommendation be referred back, but after further discussion the amendment was lost by 21 votes to 11, and the Committee's recommendation was carried.

POPLAR.—The Electricity Committee is to invite tenders for the erection of four 1,000-kW rectifier equipments, complete with control gear and spares, and has obtained sanction to borrow £25,000 for mains, £23,000 for sub-station equipment, and £960 for dust-extraction plant. The Committee has also arranged terms for the supply of electricity to the works of Dependable Furniture, Ltd., Gunmakers Lane. Rising mains are to be provided to flats at Sumner House where the tenants have applied for electric cookers.

The Committee is to discuss with the Electricity Commissioners the proposals for the installation of a 6,000-kW turbo-alternator at the Glaucus Street generating station. The borough electrical engineer has reported that, on account of the continued improvement in sales and the results for the March quarter, further tariff reductions can be effected. The Electricity Committee therefore proposes to make the following reductions: Flat rate for power from 1½d. to 1¼d. per kWh. All consumption exceeding 2,500 kWh per month to receive 10 per cent. of lighting at power rate. The public lighting fixed charge is to be reduced from £13 10s. to £10 10s.

Plymouth.—The Electricity Committee has authorised cable extensions in fifteen streets in the city.

Russia.—NEW HYDRO-ELECTRIC WORKS.—It is reported from Leningrad that the construction of a second hydro-electric works on the River Svir, 275 km. from Leningrad, has been begun. The capacity of the station will be 150,000 h.p., with four turbo-generators each of 37,500 h.p.

Floodlighting at Liverpool: St. George's Hall (left) floodlighted by 160 G.E.C. projectors including 36 "Osira" colour floodlights which illuminate the area behind the pillars with a blue light; and the Town Hall treated in a similar manner

St. Nicholas-at-Wade (Thanet).—PROSPECT OF SUPPLY.—The Ministry of Transport has informed Capt. H. H. Balfour, M.P., that the East Kent Electric Power Co., Ltd., has under consideration a tentative scheme for supplying the parish with electricity.

Shipley.—ELECTRICITY FOR COUNCIL HOUSES.—It has been decided to invite tenders for the installation of electricity in sixty-four houses on the Crag End Estate.

Stirling.—DEVELOPMENTS.—Application has been made to the Electricity Commissioners for sanction to the erection of a new sub-station. The Commissioners have sanctioned the borrowing of £11,243 for the purpose of mains, services, and meters.

Sweden.—NEW POWER STATION.—On May 30th the King of Sweden opened a power station at Vargön, near the place

where the River Göta leaves Lake Vener, says *Reuter's Trade Service* from Stockholm. This station is the third on this river, the two others being at Trollhättan and Lilla Edet. All three belong to the nation and are under the control of the Waterfall Board. The Vargön power station has been built for the production of 85,000,000 kWh a year. In the not distant future the height of the waterfall will be raised from 3.3 to 4.3 metres as the result of an adjustment of the water level in Lake Vener, which will permit an increase in the annual production to 115,000,000 kWh.

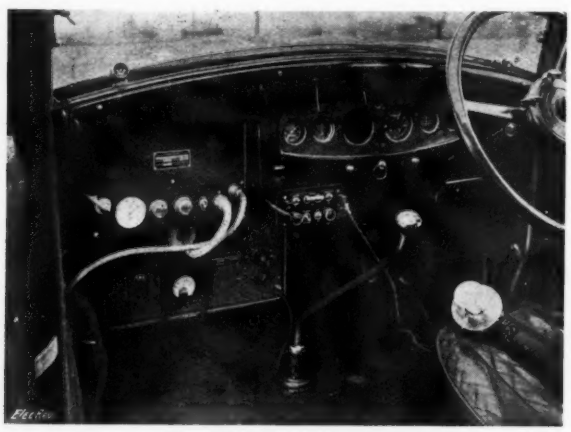
Wood Green.—STREET LIGHTING.—The Highways Committee is to install "Osira" lamps in High Road, Bounds Green Road, and Lordship Lane at a cost of £3,370.

Traction

Austria.—RAILWAY ELECTRIFICATION.—Work is in hand on the electrification of the Tauern mountain railway which connects the town of Schwarzach with Spittal. The line is in two sections connected by a tunnel about 5½ miles in length. The section on the northern side of the mountain, which is nearly 30 miles long, has already been completed. The necessary power is drawn from the Mallnitz hydro-electric station, and is stepped down to 15,000 V at a sub-station at Saint Veit near Schwarzach. The southern portion of the line, which is about 22 miles in length, and work on the electrification of which is now in progress, runs through nearly three miles of tunnels and includes steep gradients.

Belgium.—RAILWAY ELECTRIFICATION.—*The Times* Brussels correspondent reports that in order to carry out certain works, notably the electrification of the Brussels-Antwerp line, the Belgian National Railway Company is asking from Parliament authorisation to borrow 812,000,000 fr. (£4,600,000 at par).

Denmark.—RAILWAY ELECTRIFICATION DURING 1933.—The electrification of the Copenhagen suburban lines is proceeding and will be opened this year. According to a D.O.T. report, since March, 1933, the State Railways have acquired a number of electric and Diesel-electric locomotives and coaches. One result of the modernisation and electrification of the Danish State Railways is the decline in the import of British coal from 380,000 tons in 1929-30 to 325,000 tons during 1932-33.



New Marconi police wireless equipment installed in a saloon car. The receiver is next to the dashboard and the transmitter below; the control switches are on the dashboard, next to the receiver, with a Morse key above. The apparatus can be wired for two-way telegraphy or telephony

Germany.—TRAFFIC SIGNALS.—An *Exchange* message from Berlin says that experience has proved that traffic signal lights unnecessarily slow down traffic, and the president of the Berlin police has ordered the removal of the lamps from several of the busiest centres.

RAILWAY ELECTRIFICATION.—The work of electrifying the section of the German State Railways between Munich and Dachau has recently been completed and electric trains are now in regular operation over the line.

Guernsey.—TRAMWAY TO STOP.—The tramway is to stop running between St. Peter Port and St. Sampson after operating for sixty years. The Guernsey Railway Company states that for the last six years the annual loss has been about £600.

Sweden.—ELECTRIFICATION OF RAILWAYS.—The Riksdag has made a series of decisions concerning public works, says *Reuter's Trade Service* from Stockholm. The Government proposal for the electrification of new lines was accepted, and work will therefore begin at once on the State Railway lines Laxaa-Charlottenberg (on the Norwegian frontier, 203 km.), Södertaleje-Eskilstuna (82 km.), with two junction lines totalling 18 km., and Upsala-Gäfle (114 km.). The total cost of this new programme is estimated at Kr. 25,500,000, and the Riksdag has made an allowance of Kr. 15,000,000 for the next financial year for this purpose. Previous electrification of State railway lines has been quite remunerative, but the works now decided upon were not initiated by the Railway Board, which calculates that only Kr. 11,000,000 of the total cost will be a remunerative investment, but by the Government, which wishes to relieve unemployment by the organisation of large public works. As unemployment is now diminishing in Sweden, it seems probable that no further electrification work will be started for some years to come. That already going on, however, is extensive and expensive enough, and the Riksdag has just granted another allowance of Kr. 13,400,000 for the continued electrification of the line Stockholm-Krylbo-Aange (484 km.) and the junction line Orebro-Krylbo (132 km.). These works were started as a consequence of the Riksdag's decision last year, when an initial allowance of Kr. 9,000,000 was voted. The work on the two lines is estimated to cost Kr. 49,500,000. The Riksdag later in this session will have to decide regarding a proposed allowance for continued work on the west coast line between Gothenburg and Malmö with the junction line Hälsingborg-Angelholm. The total cost is placed at Kr. 28,850,000, of which the initial Kr. 11,000,000 was granted by the Riksdag in 1933.

Communications

Denmark.—PROGRESS DURING 1933.—The Department of Overseas Trade report shows that at the end of 1933 there were 533,000 listeners, *i.e.*, approximately one in seven of the total population. On January 15th, 1934, the new Copenhagen broadcasting station at Herstedvester was opened. This station, which has been designed and erected by Danish engineers, has a power of 10 kW, and supersedes the old 0.75-kW Copenhagen station. At the same time the Kalundborg station's power was increased from 30 to 60 kW. There are approximately 300,000 telephone subscribers in the country, of which 134,000 are in greater Copenhagen. The telephone system is served by six private companies and the State. The State controls the trunk service and telephone net in South Jutland. The Copenhagen Telephone Company, which is the largest of the private companies, is gradually changing over from manual service to semi-automatic service. Eight of the company's exchanges are now semi-automatic. At Odense it has been decided to build a new telephone exchange, at a cost of Kr.3,000,000.

Egypt.—EGYPTIAN STATE BROADCASTING SERVICE.—Broadcasting in Egypt is to be placed on an official basis as from yesterday, when the new State Broadcasting Service, operated by the Marconi Company on behalf of the Egyptian Government, was inaugurated. Two new broadcasting stations have been built to provide immediately a regular and efficient programme service in the most densely populated areas of the country, a high-power installation at Abu Zabal (near Cairo), and a relay transmitter at Ras-el-Tin (near Alexandria). "Sponsored programmes" will not be accepted. The Cairo station has an aerial power of 20 kW, with modulation up to 100 per cent. The transmitter can be adjusted to work on any wavelength between 200 and 545 metres. Two 305-ft. stayed masts are used to suspend the "T"-type aerial. In accordance with the practice adopted in most modern stations, the transmitter hall has been built some distance away from the line of masts, and the modulated energy is conveyed from the transmitter to the aerial by means of a two-wire high-frequency transmission feeder line carried on wooden poles. The station at Ras-el-Tin, which is to be used as a relay station for the Cairo transmissions, is semi-automatic in its operation. It has a power of 0.25 kW in the aerial, with modulation up to 80 per cent.

India.—TELEPHONY.—Our Bombay Correspondent states that the Madras Government has decided to link all the Andhra districts by telephone. Almost every important town will have a local service, and will also be connected with the surrounding towns. The installation cost and the maintenance charges will all be borne by the Government. A further message says that it is now proposed to install new short-wave wireless plant at Rangoon and Madras in order to improve the efficiency of telegraphic communications between India and Burma and provide a telephone link between them. It is also proposed to install subsidiary trunks from Rangoon connecting it with other parts of Burma.

London.—PADDINGTON AUTOMATIC EXCHANGE.—The Paddington railway station telephone exchange was switched over to automatic operation last Monday. There are a hundred Post Office lines and a thousand extensions. The average number of calls is 13,000 daily. In its construction 232 miles of wire were used on the switchboard, 85 miles of cable for the extensions, and 800 new-type telephones have been installed.

TELEVISION.—A new contract has been signed by representatives of the Baird Television Co. and Sir Henry Buckland, manager of the Crystal Palace. Additional space in the south tower has been allocated to the company so that further research may be carried out.

Palestine.—JERUSALEM.—It is claimed that there are more calls per day and per hour for each subscriber in Jerusalem than in any other part of the world. The average number of calls per telephone in Jerusalem is 37.8 per day. In industrial and commercial centres of America the average is 12, and in the United Kingdom 7 per day. Jerusalem has an average of 4.4 calls per 'phone per hour during the busiest hour of the day.

Contract Information

When "Contracts Open" are advertised in our "Official Notice" pages the date of the "Electrical Review" containing the advertisement is given in parentheses below

Contracts Open

Ashford.—June 4th. Electricity Department. One year's supply of h.p. and l.p. cables. (May 18th.)

Argentina.—BUENOS AIRES.—June 18th. State Oilfields. Four centrifugal pumps coupled direct to three-phase motors. (G.Y. 13827.)*

Australia.—MELBOURNE.—Posts and Telegraphs Department. June 19th. Multiple-twin lead-covered telephone cable. (A.Y. 12345.)* Common battery, floor pattern p.b.x. cord type switchboards. (A.Y. 12378.)*

Barking.—June 12th. Electricity Department. Three 250-kVA and two 400-kVA transformers, one 230-kW glass bulb rectifier, and one 500-kW glass bulb rectifier or steel tank rectifier. (May 25th.)

Barnes.—June 12th. Electricity Department. Glass-bulb mercury vapour rectifier plant. (May 11th.)

Belfast.—June 11th. Electricity Department. 33-kV cables (underground and submarine) with overhead switching equipment. (See this issue.)

Birmingham.—June 4th. Corporation. Installation of three electric lifts at new central fire station. Specification from City Engineer, Council House (deposit £2).

Blackpool.—June 13th. Corporation. Electrically driven centrifugal pumps of non-choking type for pumping screened sewage, with starters for hand or automatic float operation. Specifications from Borough Surveyor.

Bolton.—June 6th. Housing Department. Electrical installations at twenty-six houses on the Hall i' th' Wood estate. Specifications from Housing Director, Westminster Bank Chambers, Old Hall Street North; tenders to S. Parker, town clerk, Town Hall.

Bristol.—June 30th. Electricity Department. CO_2 fire protective equipment. (May 25th.)

Bromley.—June 11th. Electricity Department. L.p. cable, 660 V e.h.p. cable, and pilot cable. (See this issue.)

Buckhaven and Methil (FIFE).—June 5th. Town Council. Various works, including electric lighting, at sixteen houses at Methil. Specifications from E. L. Forsyth, architect, Methilbrae; tenders to Town Clerk.

Carlisle.—June 8th. Electricity Department. Transformers. (May 18th.)

Cheadle & Gatley.—June 18th. Electricity Department. Extensions to existing 6.6-kV switchgear and 6.6-kV switchgear for the Ramillies Avenue sub-station. (See this issue.)

Clyde.—June 9th. Navigation Trust. Supply of electrical stores. Specifications, &c., from Stores Department, 1, Graving Dock, Govan; tenders to J. Macfarlane, general manager and secretary, 16, Robertson Street, Glasgow.

Croydon.—June 4th. Corporation. Rubber-insulated cables and meters for period July 1st, 1934, to March 31st, 1935. (May 18th.)

Eastbourne.—June 12th. Electricity Department. High-voltage pressure testing equipment. (May 25th.)

Edinburgh.—June 8th. Corporation. Electrical installations at Darroch Royal High Secondary and James Gillespie's Schools. Schedules from City Architect; tenders to Town Clerk.

Egypt.—CAIRO.—July 12th. Ministry of the Interior. Material required for the extension of the electrical network at Mehalla el Kobra. (A.Y. 12361.)*
June 14th. Material required for electric lighting installation for Toukh. (A.Y. 12317.)*
June 11th. Electrically driven vertical-spindle pump. (G.Y. 13794.)*

Farnborough.—June 20th. U.D.C. Electric syren at the fire station. Particulars from Offices of the Engineer and Surveyor; tenders to J. G. Kingdon, clerk to the council, Town Hall.

Gainsborough.—June 8th. Electricity Department. Transformer kiosk, complete with 250-kVA transformer and switchgear. (May 25th.)

Grantown.—June 30th. Town Council. Various works, including electric lighting, at housing scheme. Shedules from T. M. Jaffrey, architect, Grantown-on-Spey (deposit £1); tenders to Town Clerk.

Inverness.—June 1st. District Asylum Joint Committee. Electrical generating plant at the Asylum. Schedules, &c., from R. Gilbert, clerk, 20, Church Street.

Irish Free State.—DUBLIN.—June 5th. Joint Committee of Grangegorman Mental Hospital. Overhaul of the electrical installation at Portrane Mental Hospital. Specifications from J. P. Tierney & Co., 44, Kildare Street (deposit £5 5s.); tenders to J. J. Doyle, Grangegorman Mental Hospital.

Keighley.—June 5th. Electricity Department. Metal-clad e.h.p. switchgear. (May 11th.)

Lancaster.—Electricity Department. Transformers. (See this issue.)

Leeds.—June 16th. Wiring at Menston Mental Hospital. Particulars from W. E. H. Burton, Mental Hospital, Wakefield (deposit £2 2s.).

London.—BATTERSEA.—June 6th. Borough Council. Four e.h.p. feeder switches. (May 18th.)
CENTRAL ELECTRICITY BOARD.—June 28th. 132,000-V transformers and 66,000-V and low-voltage transformers. (May 25th.)
H.M. OFFICE OF WORKS.—June 15th. Electrical accessories. (See this issue.)
ISLINGTON.—June 7th. Borough Council. Electrical installation at City and Queen's Mansions, Holloway. (May 18th.)
METROPOLITAN WATER BOARD.—June 20th. Two electrically driven vertical centrifugal well pumps and two sets of electrically driven horizontal centrifugal high-lift pumps, piping, &c., at the Rye Common pumping station. Specifications from the Chief Engineer, 173, Rosebery Avenue (deposit £2 2s. with the Accountant).
POPLAR.—June 6th. Four 1,000-kW rectifier equipments. (May 25th.)

Midlothian.—June 6th. County Council. Various works, including electrical, at housing schemes. Schedules from County Architect, 10, Drumsheugh Gardens, Edinburgh.

Morocco.—RABAT.—June 11th. Postal, Telegraph and Telephone Administration. Telephone cable and wire, and instrument cords. (A.Y. 12381.)*

Newcastle-on-Tyne.—Education Committee. Installation of electric lighting at the Victoria Jubilee and the Westgate Hill schools. Plans by T. Walling, director of education, Northumberland Road.

Newport (Mon).—June 23rd. Electricity Department. Electrically driven circulating water pumps, switchgear and water screening plant. (See this issue.)

New Zealand.—WELLINGTON.—Post and Telegraphs Department. July 3rd. Telephone instrument and switchboard cords. (A.Y. 12363.)*
July 4th. Telephone keys and key-mountings. (A.Y. 12366.)* Metal-cased condensers. (A.Y. 12364.)*
July 24th. 100,000 rubber insulator rings. (F.Y. 2036.)*

Northern Ireland.—BELFAST.—June 7th. Down County Educational Committee. Electric lighting installation for Newtownards Technical School. Particulars from D. C. Quail, director of education, 1, Wellington Place.

Nottingham.—June 19th. Electricity Committee. General stores for twelve months. (See this issue.)

Sheffield.—June 4th. Electricity Department. Two 30,000-kW turbo-alternators, complete with condensing plant and auxiliaries, and six 150,000 lb. water-tube boilers with associated equipment. (May 14th.)

Shipley.—June 12th. Electricity Department. E.h.p. and l.p. cables. (May 18th.)

South Africa.—JOHANNESBURG.—Municipality. June 14th. Supply of electric lamps for twelve months commencing September 1st. (A.Y. 12369.)* Three sets of vehicle-actuated road traffic signals and three sets of fixed time interval signals. (A.Y. 12370.)* Six three-phase drop-down type switchboard cubicles. (A.Y. 12375.)* One four-unit and one seven-unit metal-clad l.p. a.c. switchboards. (A.Y. 12374.)*
June 21st. H.p. cable. (A.Y. 12386.)*
June 21st. House-service cut-outs. (A.Y. 12389.)*
Rand Water Board. June 11th. Two double-wound oil-immersed, outdoor-type 250-kW transformers. (A.Y. 12385.)*
PRETORIA.—Government Supplies Board. June 15th. One stationary battery. (A.Y. 12373.)*

Stoke-on-Trent.—June 13th. Electrical Engineer's Department. Three-phase motors. (See this issue.)

Tain.—June 26th. Town Council. Various works, including electric lighting, at twenty houses. Schedules from J. H. Hinton Gall & Son, architects, 13, Lombard Street, Inverness; tenders to Town Clerk.

Tamworth.—June 18th. Sewage Disposal Joint Committee. Removal of existing pumping plant and installation of two centrifugal pumps with electric motors and equipment, connecting pipes and incidental works. Specifications from Dodd & Watson, 3, Central Buildings, S.W.1 (£2 2s.).

Totnes.—June 14th. Town Council. Electric motors and centrifugal pumps in connection with water supply works. Particulars from J. W. Smith, borough engineer; tenders to G. E. Windeatt, town clerk.

Uruguay.—MONTEVIDEO.—July 27th. State Electricity Supply and Telephones Administration. Bare copper conductors and telephone lines. (G.Y. 13853.)*

Weymouth & Melcombe Regis.—June 15th. Electricity Department. 11,000-V overhead and underground line and l.p. overhead lines. (May 18th.)
June 5th. Cables. (See this issue.)

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* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed

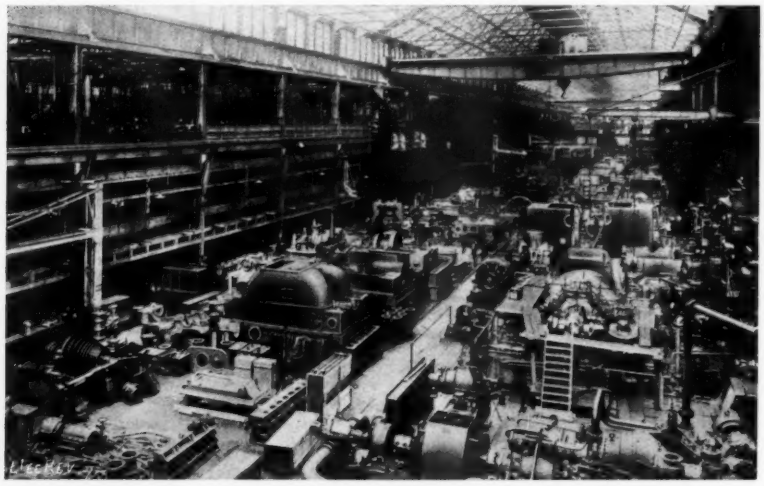
Bexhill.—Electricity Committee. Accepted. Transformers: Two 300-kVA (£385) and two 500-kVA (£524).—British Electric Transformer Co., Ltd. Cable (£343).—Telegraph Construction & Maintenance Co., Ltd.

Glasgow.—Transport Committee. Accepted. Switchgear for Rutherglen sub-station.—Metropolitan-Vickers Electrical Co., Ltd. Trolley wire.—W. F. Dennis & Co. Battery-charging sets for subway signalling.—Westinghouse Brake & Saxby Signal Co., Ltd. Tramway motors.—Macfarlane Engineering Co., Ltd. Twelve months' supply of electrodes.—Clarkson & McGregor; British Oxygen Co., Ltd.; W. Gilmour Smith & Co., Ltd.; Welding Rods, Ltd.
Housing Committee. Accepted. Electrical fittings and cables.—W. McGeoch & Co., Ltd.; General Electric Co., Ltd.

Electrical installation at shops at Holmlea Road.—R. J. McIntyre.

Kettering.—Water Committee. Accepted. Pumping plant with electric motor at waterworks (£340).—Mather and Platt.

London.—BATTERSEA.—Electricity Committee. Recommended. Two 500-kVA transformers (£434).—British Electric Transformer Co., Ltd. Switchgear (£1,559).—Switchgear & Cowans, Ltd. Supplies for eleven months: Electricity meters.—Chamberlain & Hookham, Ltd.; Ferranti, Ltd. Cables, cut-outs, and service joint boxes.—Callender's Cable & Construction Co., Ltd.
STEPNEY.—Electricity Supply Committee. Recommended. Cables (£1,020).—Wholesale Fittings Co., Ltd. Semi-fluid resin and oil compound (£94).—W. T. Henley's Telegraph Works Co.,



The Metro-Vick works, Trafford Park, visited by I.M.E.A. Convention delegates

Ltd. Superheaters at the Limehouse generating station (£1,996).—Superheater Co., Ltd.
POPLAR.—Contracts Committee. Traffic signals (£760).—Automatic Electric Co., Ltd.
HAMMERSMITH.—Electricity Committee. Recommended. Switchgear in connection with the supply of electricity to Hammersmith Road (£741).—British Thomson-Houston Co.

Roxburgh.—County Council. Accepted. Electrical installation at new school at Trinity, Hawick (£229).—W. Paisley & Son.

Stirling.—Town Council. Accepted. Two 250-kW glass-bulb mercury arc-rectifier equipments (£3,678).—Bruce, Peebles & Co., Ltd. Electrical work in houses at Bannockburn Road.—J. Scott & Co.

Warwickshire and Coventry.—Joint Committee for Tuberculosis. Accepted. Electrical work at the sanatorium (£828).—B. French, Ltd.

Forthcoming Events

Institution of Electrical Engineers (*London Students' Section*).—Saturday, June 2nd. Summer outing. Tour of the electrification scheme of the Southern Railway. (*South Midland Centre*).—Wednesday, July 4th. Summer meeting. Visit to Messrs. Callender's cable works.

Overhead Lines Association.—Saturday, June 2nd. Summer meeting. Visit to Stourport power station.

Batti-Wallahs' Society.—Wednesday, June 6th. Hotel Metropole, W.C.2. 12.55 for 1 p.m. Luncheon. "Trade with Russia." Mr. H. E. Metcalf.

Institution of Heating and Ventilating Engineers.—June 18th-20th. Summer meeting at Queen's Hotel, Hastings.

Electrical Contractors' Association.—June 27th-29th. Annual conference at Buxton.

Notes

Consulting Engineers' Annual Meeting

At the annual general meeting of the Association of Consulting Engineers in London on May 17th Mr. A. M. Sillar, chairman of the Committee, in presenting the annual report, said that the growth of membership last year was not so large as it might have been. The articles of association have been amended to enable certain officials to continue to advise the Committee, if desirable, after their period of office has expired. The Association has drafted some "Notes on the Professional Duties of Consulting Engineers" and they are to be discussed at a special meeting on June 11th.

I.E.E. Western Centre Summer Meeting

An interesting week-end was spent by members of the I.E.E. Western Centre recently, when they held their annual summer meeting at Chepstow. The business meeting was concluded on Friday, May 11th, by a dinner (by invitation of the Ediswan Co.) and dance, and Saturday and Sunday morning were devoted to a treasure hunt and visits to the surrounding country. A golf match, North *v.* South of Bristol Channel, for the past chairman's cup, was played, and there was an informal dinner at the hotel.

I.E.E. (Scottish Centre)

The Scottish Centre of the Institution of Electrical Engineers has removed to 154, West George Street, Glasgow, C.2.

An Engineer's Electrical Installation

Those who desire to utilise electricity fully in their homes may find some hints in the following particulars of electrical apparatus (apart from lighting, clocks and radio) installed at the private residence at "Kenmure," St. Albans, of Captain J. M. Donaldson, chief engineer, Northmet Co. In the kitchen and scullery there are an "Xcel" table cooker, Bulpitt kettle, Belling fire, Electrolux refrigerator, "Canvary" water heater, washing and wringing machine, and copper. The dining room contains a Berry "Sunray" three-tube heater (under the table), "Inventum" fire, hot-plate, warming-plate, percolator and toaster, and the study a "Beauberry" fire and a Berry "Sunray Christmas tree" (one lamp). An electrically operated piano is a prominent feature of the drawing room; this is kept in condition by a thermostatically controlled "Genii" heater. General heating is by a Ferranti and a Berry "Sunray" fires. The temperature of the hall is kept at a minimum of 53 deg. F. by four 90-W thermostatically controlled tubular heaters on the ground floor and on the first-floor gallery. The thermostat on the first floor also controls an independently operated "Genii" heater on the wall. Additional heat can be provided by a Berry "Sunray" fire (three-tube). Among the electrical appliances in the bedrooms is an electric exerciser, and in the bathroom a 20-gal. Ferranti water heater, an illuminated shaving mirror, hair-dryer, electric razor, and a Ferranti fire, which we noticed was controlled from outside. Hot water is provided for the downstairs lavatory by an under-basin push-through water heater. In the garage a 360-W Bertram Thomas tray type heater, thermostatically controlled, has solved starting difficulties in cold weather. The greenhouses are heated by four 1,190-W thermostatically controlled tubes; one of the existing frames is being converted to a forcing frame by the addition of two tubular heaters and ground heating. There are also an electrically warmed seed propagating frame and an electric lawn mower.

I.E.E. Golf Competition

Held under the auspices of the Liverpool Centre of the Institution of Electrical Engineers, a golf competition, with the object of benefiting the benevolent fund, took place over the course of the Royal Liverpool Club on May 24th. The G. P. Dennis trophy and replica, for the best net score against bogey returned by a member of the institution, was won by Messrs. P. W. Davis (Sandwell Park, Birmingham), and E. Ashton (Fleetwood) won the first prize for the best score against bogey, open to both members and friends. Other winners were: Medal play, class A, Messrs. T. H. Garner and P. W. Davies; class B, Messrs. T. W. Whyte and E. G. Pulford; four-ball competition, Messrs. G. Clarke and T. M. Dowell (the second prize going to Messrs. J. Boucher and B. T. Hawkins); putting competition, Messrs. G. H. Walton, J. E. Allan and F. K. Ewart.

Fatality

A verdict of "accidental death" was recorded at the inquest on Mrs. I. F. Pike, who was killed in her garden by coming into contact with some "live" wire netting while watering plants. A lead-covered cable ran along the netting from the sitting-room next door to a shed at the bottom of the adjoining garden, and the copper conductor at a joint between the house supply and the extension was in contact with the lead covering of the cable. Neither the cable nor the netting was earthed.

Appointments Vacant

Temporary mains assistant for Fulham Electricity Department.

Temporary switchboard attendant for Scarborough Electricity Department.

Temporary appliance inspector for Bingley U.D.C. Electricity Department.

(See our classified advertisements.)

Makers' Names Wanted

CRESCENT junior switch.
HANDYHOT electrical appliances.
HANDYBREEZE fan.
HARDALE vacuum cleaner.
SAFEWAY adaptors.
VARIOFLAKE flexible shaft or couplings.

Our Personal Column

Electrical men are invited to keep readers of the "Electrical Review" posted concerning their movements

The boards of directors of the Charing Cross Electricity Supply Co., Ltd., and the Westminster Electric Supply Corporation, Ltd., announce that they have entered into an arrangement to exchange directors. In compliance with this arrangement, **Mr. J. A. Gatti,** managing director of the Charing Cross Electricity Supply Co., Ltd., has been appointed a director of the Westminster Electric Supply Corporation, Ltd., and **Mr. C. Parker,** director and general manager of the Westminster Electric Supply Corporation, Ltd., has been appointed a director of the Charing Cross Electricity Supply Co., Ltd.

Mr. F. Wright, A.M.I.E.E., chief electrical engineer to Messrs. Matthews & Yates, Ltd., Swinton, was married on May 30th, at St. Peter's Church, Swinton, to Miss Evelyn Muriel Salt, of Swinton. After the reception Mr. and Mrs. Wright departed for Switzerland, where they are spending their honeymoon. Mr. Wright's new address will be 1, Vale Drive, Sandy Lane, Prestwich, Lancs.

Mr. G. A. Vowles, on leaving Hull to become borough electrical engineer at Halifax, has been presented by the staff with a gold cigarette case and with a silver condiment set for Mrs. Vowles. He has also received from the Corporation a copy of a resolution of appreciation of his services, passed by the Electricity Committee, engrossed on vellum.

The Inquiry Commission which is investigating Johannesburg's public transport system, under the chairmanship of **Mr. C. J. Spencer,** of London, is now starting on the second part of its investigation—the organisation and running of the city power station and workshops. **Mr. A. L. Barber,** who went out with Mr. Spencer as statistical adviser, has now returned to London. At a farewell function in Johannesburg it was disclosed that both Mr. Spencer and Mr. Barber were giving their services free as a gesture of goodwill from British industry to South African public transport undertakings. Before returning, Mr. Spencer has promised to visit Bloemfontein to investigate and report on the transport system there.

Mr. H. Brierley, distribution superintendent at Croydon, has been appointed by the Corporation Electricity Committee as chief technical assistant at a salary of £750, rising to £850. **Mr. H. C. Spence,** the deputy distribution engineer, has been promoted to the position of distribution superintendent at a salary of £570.

Capt. J. Coxon, executive engineer of the North Wales district of the Post Office Engineering Department, and **Mr. H. D. Smith,** efficiency engineer of the North Wales district, have retired from those positions. Capt. Coxon, who is chairman of the South Midland Centre of the Institution of Electrical Engineers, joined the Post Office Engineering Department in 1903, after considerable experience in general electrical engineering work at home and in South Africa. He was appointed power engineer of the North Wales Engineering District in 1926 and became executive engineer two years later. He has started in practice as a consulting engineer, specialising in bulk supply negotiations and supplies and in power, lighting and ventilating work. His temporary office is at 25, Streetsbrook Road, Shirley, Birmingham.

[H. J. Whitlock & Sons
Capt. J. Coxon

Mr. Smith entered the Post Office in 1892 and went to the North Wales district in 1924 as assistant engineer, later becoming efficiency engineer. Presentations to the two officials were made recently by Mr. R. A. Weaver, superintending engineer, on behalf of the staff. Capt. Coxon was presented with a wardrobe and bookcase, and Mr. Smith with a gold watch.

Mr. J. H. Bryan, canvasser and consumers' adviser in the St. Pancras Electricity Department, has been recommended by the Parliamentary and General Purposes Committee for an increase in salary from £450 to £500 per annum. It is proposed to alter the title of his position to "consumers' adviser."

Sir Montague Hughman has been elected a director of Enfield Rolling Mills, Ltd., to fill the vacancy caused by the death of Sir George Sutton, Bt.

Mr. R. H. Line has resigned from the Electric Domestic Appliance Co. and the Forward Electric Co., Ltd., of Perry Barr, Birmingham, and is joining, almost immediately, the Co-operative Wholesale Society, Ltd., at its new works in Dudley, where a full range of heating, cooking, and other electrical appliances will shortly be in production.

Mr. G. S. Wade, the son of Mr. E. S. Wade, a director of Messrs. Gabriel, Wade & English, Ltd., has been appointed to the board of that company in succession to Mr. W. L. Shooter, whose death is recorded in our Obituary section to-day. Mr. Wade will have charge of the Pole Department, of which he has been assistant manager for many years.

[H. J. Whitlock & Sons
Mr. W. L. Sims, the author of the article on "A Modern Woodworking Mill" which appears on page 799

Mr. A. G. Jones, who recently resigned his position as London manager for Messrs. A. Rist, Ltd., has joined the Kniveton Cable Works, Ltd., of Ponders End, Middlesex, as sales director.

There was to be placed before the meeting of the Stepney Borough Council on Wednesday evening a report of the General Purposes, Staff and Education Committee with reference to a letter of resignation that had been received from **Mr. W. C. P. Tapper,** the consulting electrical engineer and manager. Mr. Tapper has been associated with the Stepney undertaking since its inception and, on medical advice, he desires to be relieved of the strain entailed by his office as soon as a successor is appointed, and, preferably, by the end of July. The Committee, after giving the matter very careful consideration, approved of the course suggested by Mr. Tapper, and recommended that he be granted superannuation from the date on which he ceased to hold office and given a testimonial under the seal of the Council. The Committee further recommended that a successor be advertised for.

Mr. J. C. Callander, station superintendent at the Limehouse generating station of Stepney Borough Council, has been recommended by the General Purposes Staff and Education Committee for the appointment of technical assistant to the deputy electrical engineer at his present grading. It is proposed to advertise for a station superintendent.

We learn from Mr. J. H. Lumsden, the chief engineer of the Stalybridge, Hyde and Dukinfield Tramways and Electricity Board that two members of his showroom staff—**Miss Hartley,** the demonstrator and **Miss Firth,** showroom assistant—have recently passed the E.A.W. electrical housecraft examination and have obtained their certificates.

Mr. D. Pearmain has resigned from the General Electric Co., Ltd., and taken up the position of advertisement manager with the Mayfair Press, Ltd., which is taking over the publication of *Decoration*. His address is Crown House, 143-7, Regent Street, W.

Obituary

Mr. E. Pearce.—The death has taken place at Newcastle-on-Tyne of Mr. Edward Pearce, who retired five years ago from the post of electrical engineer at the Celanese Works, Spondon, near Derby. He was a native of Devonshire, but had lived in Newcastle the greater part of his life. He leaves a widow and one son.

Mr. D. Grosart.—The funeral took place in Dublin, on May 25th, of Mr. David Grosart. He was a native of Blackburn and served an apprenticeship as an electrical engineer with Mr. John Barton, a Blackburn contractor. Later he went to Dublin, where he became manager of the Lucan (Dublin) Tramways, from which position he retired through failing health.

Mr. W. L. Shooter.—The death has occurred of Mr. W. L. Shooter, a director of Messrs. Gabriel, Wade & English, Ltd., who was in charge of the Pole Section of the business.

Mr. E. Coates, an electrical engineer of Stockton and a former member of the Corporation Lighting and Power Committee, has died at the age of fifty-two.

Mr. T. Devitt, late Eastern Telegraph Co., died on May 11th at Worthing at the age of eighty-five.

Dr. G. Seibt.—The death is reported from Berlin, at the age of sixty years, of Dr. Georg Seibt, a leading German authority on wired and wireless telephony.

Will.—**Mr. W. J. Fryer,** of Walmer House, Regent Street, W., consulting engineer, and inventor of many electrical and mechanical devices, left £194,426 (net personalty nil).

Financial Section

New Companies, Returns of Share Capital, Debenture Charges, Reports of Electrical Companies, Dividend Changes, Transactions in Stocks and Shares

New Companies Registered

Tungsten Contacts, Ltd.—Private company. Registered May 23rd. Capital, £100 in £1 shares. Objects: To carry on the business of manufacturers of tungsten, tungsten contacts, screws, electrical parts and accessories, general and mechanical engineers, &c. The first directors are: A. J. Blake, 47, Essex Park, Finchley, N.3, and two others. Secretary: A. J. Blake. Registered office: 3, Haverstock Hill, N.W.3.

J. H. Blount & Co., Ltd.—Private company. Registered May 17th. Capital, £800 in £1 shares. Objects: To carry on the business of electrical and mechanical engineers and contractors, manufacturers and repairers of and dealers in dynamos, motors, armatures, magnetos, batteries, conductors, insulators, &c. The first directors are: J. H. Blount, 11, Wrottesley Road, Tettenhall, Wolverhampton, and two others. Registered office: Regent Chambers, 44, Lichfield Street, Wolverhampton.

General Wireless Relay Co., Ltd.—Private company. Registered May 22nd. Capital, £100 in £1 shares. Objects: To carry on the business of erecting, equipping, and working wireless relay stations, &c. The subscribers are: W. P. Pearson, Polebrook House, Golden Square, W., and V. T. Toy, Oaklands Grove, W.12. Registered office: 3, Polebrook House, Golden Square, W.1.

Master Heater Co. (Great Britain), Ltd.—Private company. Registered in Edinburgh May 23rd. Capital, £12,000 in 10,000 cumulative preference shares of £1 and 40,000 deferred shares of 1s. each. Objects: To acquire interests in any patents relating to the production, treatment, storage and use of electricity, or apparatus, appliances and devices therefor, &c. The first directors are J. O. Marcelais, 115, Port Dundas Road, Glasgow, and R. M. McGowan, 175, West George Street, Glasgow. Registered office: 115, Port Dundas Road, Glasgow.

Boardman's (Rochdale), Ltd.—Private company. Registered May 25th. Capital, £100 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in electrical and wireless components, apparatus, accessories and equipment; dealers in hire purchase or other systems, &c. The directors are: M. Laughtenberg. Ashdown, Midleton Road, Manchester, and J. Lee, 28, Darlington Street, Cheetham. Manchester. Solicitors: Cyril Simons, 26, King Street, Manchester.

Midlothian Electric Co., Ltd.—Private company. Registered in Edinburgh May 25th. Capital, £500 in £1 shares. Objects: To carry on the business of mechanical and electrical engineers and manufacturers, &c. The subscribers are: : R. F. Smith, Drumsheugh Gardens, Edinburgh, and M. G. Kidd, 4a, St. Andrew Square, Edinburgh, W.S. Solicitor: M. G. Kidd.

Sebut Electrical Co., Ltd.—Private company. Registered May 26th. Capital, £1,000 in 10s. shares. Objects: To carry on the business of electrical engineers and contractors and manufacturers of and dealers in all apparatus connected with electricity, &c. The directors are: A. W. Blair, 36, Chapel Road, W. Norwood, and C. H. Roddis, 88, Kent House Road, Beckenham, Kent. Registered office: 14, Queen Victoria Street, E.C.4.

Returns of Electrical Companies

Martin Bros. (Machinery), Ltd.—Mortgage, dated April 30th, 1934, to secure £1,000, and any other moneys due or to become due from the company to the chargees. Property charged: Certain land and buildings in Trafford Park, Stretford, Lancs. Holders: Leek and Moorlands Building Society.

Wickford & District Electricity Supply Co., Ltd.—The nominal capital has been increased by the addition of £20,000 in £1 ordinary shares beyond the registered capital of £10,000.

St. Paul's Radio, Ltd.—The nominal capital has been increased by the addition of £1,000 beyond the registered capital of £800. The additional capital is divided into 700 10 per cent. redeemable cumulative participating preference shares and 300 deferred shares of £1 each.

Hastings Factors, Ltd.—The nominal capital has been increased by the addition of £3,000 beyond the registered capital of £1,000. The additional capital is divided into 3,000 7½ per cent. cumulative preference shares of £1 each.

Insular Electric Glowlamp Works, Ltd.—The nominal capital has been increased by the addition of £4,000 beyond the registered capital of £1,000. The additional capital is divided into 400 ordinary shares of £10 each.

Thames Valley Radio Service, Ltd.—F. A. Bemmer, 29, King William Street, E.C., and 221, High Street, Hounslow, ceased to act as receiver and manager on May 14th, 1934.

Machynlleth Electric Supply Co., Ltd.—Capital, £7,000 in £5 shares. Return dated December 26th, 1933. All shares taken up. £7,000 paid. Mortgages and charges nil.

Bideford & District Electric Supply Co., Ltd.—The nominal capital has been increased by the addition of £20,000 in £1 ordinary shares beyond the registered capital of £80,000.

British Pix Co., Ltd.—The nominal capital has been increased by the addition of £900 in £1 ordinary shares beyond the registered capital of £100.

London Nigerian Power Co., Ltd.—Satisfaction in full on October 12th, 1933, of £200,000 7½ per cent. first mortgage debenture stock secured by trust deed dated June 10th, 1930, and registered June 25th, 1930. (Notice filed May 15th, 1934.)

Mead & Jeffery, Ltd.—Satisfaction to the extent of £900 on May 9th, 1934, of mortgage dated November 6th, 1919, and registered November 7th, 1919.

Hessle Relay Service, Ltd.—Mortgage on house, shop, &c., in Prestongate, Hessle, Yorks, dated April 18th, 1934, to secure £500. Holder: A. Gosschalk, 294, West End Lane, Hampstead.

New Era Line & Telephone Systems, Ltd.—Particulars filed of debenture stock to secure £20,000, and bonus of 5 per cent., authorised May 4th, 1934, and covered by trust deed of same date, charged on contracts for the purchase or hire of telephone installations and the company's property, and estate therein, rents and sums due and to become due thereunder, and the company's undertaking and other property, present and future, including uncalled capital, the amount of the present issue being £2,000. Trustees: J. P. Parrish, Woodgarth, Broad Road, Sale, Ches; and J. Toole, 462, Wellington Road North, Heaton Chapel, Stockport.

Deco Radio Products (Hampton), Ltd.—W. F. Baker, 8, Kings Avenue, Greenford, was appointed receiver and manager on May 9th, 1934, under powers contained in debenture dated July 12th, 1933.

Sentry Dry Battery Co., Ltd.—S. F. Homewood, 1, Queen Victoria Street, E.C., ceased to act as receiver and manager on May 15th, 1934.

Insulators, Ltd.—Capital, £5,000 in £1 shares. Return dated September 13th, 1933 (filed April 27th, 1934). 4,000 shares taken up. £4,000 paid. Mortgages and charges nil.

Western Radio & Supplies, Ltd.—Capital, £500 in £1 shares. Return dated December 31st, 1933 (filed April 6th, 1934). 500 shares taken up. £2 paid, £498 considered as paid. Mortgages and charges: £400 debenture.

Cheadle Electric & Radio Co., Ltd.—Capital, £1,000 in £1 shares. Return dated December 13th, 1933 (filed April 3rd, 1934). 395 shares taken up. £395 paid. Mortgages and charges nil.

Fairbourne Development Co., Ltd.—Capital, £1,000 in £1 shares. Return dated December 31st, 1933 (filed February 5th, 1934). 660 shares taken up. £660 paid. Mortgages and charges nil.

City Notes

Siemens Bros. & Co., Ltd., held their annual meeting on May 25th, Lord Queenborough (chairman) presiding. In presenting the report and accounts (ELECTRICAL REVIEW, May 25th, page 759), the chairman reminded shareholders that he mentioned in his speech last year that orders were not coming in freely, that profits were falling severely, due to insufficiency of orders and heavy price-cutting competition, and that this might be reflected in future dividends. This forecast had proved only too accurate. Business in submarine cables was confined to the comparatively small quantities of telegraph cable needed for maintenance purposes, and in consequence the plant necessarily remained idle for considerable periods. Orders were executed for the French Telegraph Cable Co. and the British Post Office, and at the present time a few more inquiries than usual were being made for submarine telegraph cable for repairing and other purposes. With regard to submarine telephone cable, in face of severe competition they were awarded the contract for the manufacture of the first telephone cable to be laid between India and Ceylon. They had also received from the British Post Office a contract for the manufacture and laying of another cable from the mainland to the Isle of Wight. Further schemes involving the use of submarine telephone cables were being considered. The requirements of the Post Office for underground telephone cables last year were much below normal. Among overseas contracts secured was one for Lithuania. The progressive policy adopted by the Post Office should render it necessary to make substantial additions to the underground cable network of the United Kingdom, and they might reasonably hope to get a fair share of the work which such development would entail. It was reassuring for the immediate future to find that their plant for the manufacture of underground telephone cable was more fully occupied just now than it had been at any period during the past three years, and there were grounds for believing that this state of affairs would prevail for some time. So far as the home market for underground power cables was concerned, the period under review was one of very low demand. A contract for the supply of a 33,000-V cable for Durban followed the completion of the contract for the Cape Town Corporation, and power cables were supplied to other South African municipalities as well as to other parts of the Dominions. They had devoted considerable attention to the design and manufacture of accessories associated with underground cables, such as junction and service boxes. During 1933 a reduced but steady demand both for new telephone exchanges and for extension of existing equipments reached them both from home and overseas sources. Among contracts placed for automatic exchanges in the London area was the "North" exchange. Other exchanges on order included eight automatic exchanges in the Belfast area, with an aggregate capacity of 16,300 lines. In connection with trunk-demand equipment for providing a no-relay service on trunk calls, they had extended this facility to Brighton, Chatham, Colwyn Bay, Hereford, Kirkcaldy, Sheffield and Southampton. One public exchange in the London area and eleven in provincial areas were brought into service. A new automatic system making use of a switch which operated at 200 steps per second had been developed by their engineers, and the trial equipment installed in the Livingstone Exchange was put into service in April. Among overseas contracts were an auto exchange at Gwelo and an extension of the existing auto exchange at Salisbury, Rhodesia; extensions of three auto exchanges in the Pernambuco area; and an extension of the manual exchange in Malta. The Cape Town exchange was brought into service in January and they also put into operation seven public exchanges and two extensions of existing exchanges. They received substantial orders for telephone apparatus and materials from home and overseas telephone administrations in which

their "Neophone" instruments were well to the fore. Among others, contracts were received from the Post Office for sixteen rural exchanges and private telephone equipments of a new type. Their rental and maintenance business in private telephones had made good progress, and equipments had been supplied to a large number of institutions, factories and business houses. On behalf of their associated company, the Siemens & General Electric Railway Signal Co., Ltd., they installed a train-arrival indicator at Paddington which was the first of its kind. The primary battery business with Government Departments, municipalities, and railways continued to be maintained. The adverse state of the shipping industry continued to affect their marine wireless service, but in the supply of other marine specialities an improvement had taken place. The total business invoiced by their overseas branches during 1933 showed a slight increase over the previous year, but the business invoiced through overseas agents or direct to customers abroad was considerably less, and consequently there was a decrease on their total overseas business for the year. Siemens Electric Lamps & Supplies, Ltd., continued to show satisfactory results. In conjunction with other leading lamp manufacturers, the lamp company was proposing to place on the market in September a newly developed lamp, with a considerably improved efficiency, for general lighting purposes. Orders received for the first four months of the current year showed a substantial increase, but at a price level which continued to cause much concern.

Cables & Wireless, Ltd.—Presiding at the annual meeting held on May 25th, Mr. J. C. Denison-Pender (governor) said that the dividends receivable from subsidiary companies showed an increase of £18,000. Working expenses at stations showed a decrease of £449,000, of which over £300,000 represented a decrease on their own system. They had handed over the operation of the cables in South Africa, India and Egypt to local companies and were consequently relieved of the expenses of the branches of those areas. On the other hand they had acquired other undertakings and were working the Persian Gulf cables. They had erected a wireless station at Salisbury, Southern Rhodesia, and had extended the wireless station which they had acquired at Nairobi. There had also been extensions of their wireless plant in this country. Taking all those facts into consideration they had reduced the expenditure by nearly £1,000,000 per annum. The merger in 1928 was the outcome of recommendations formulated by the Imperial Wireless & Cable Conference. The terms of the arrangement were negotiated at a time when general world conditions were more prosperous compared with those which followed, and he had over the last few years made constant representations with a view to securing a reconsideration of certain elements of the agreements of 1929 and an adjustment of other factors which had developed since that date. He had asked for a re-examination of the whole question of external telephony from this country, which service was at present conducted by the Post Office. Although this service was not likely at the present time to be financially remunerative, there was little doubt that external telephony was likely to become a competitor with external telegraphy. In this respect the rationalisation of external services sought by the Imperial Wireless & Cable Conference was incomplete, and in the board's view the time had come when this rationalisation should be completed by handing over all external telegraphic and telephonic services to the company. He regretted that the Government had not been able to see its way either to modify the "charter" under which the company worked, or to examine with them developments in communications which the march of time had brought about within the last four years.

At a subsequent extraordinary meeting a resolution was passed altering the title of the company to "Cable & Wireless (Holding), Ltd."

Marconi's Wireless Telegraph Co., Ltd., held its annual meeting on May 23rd, when Lord Inverforth (chairman), who presided, said that in proposing the payment of a dividend of 6 per cent. on the ordinary shares they were not departing from a policy of extreme prudence. In 1933 they appropriated an extraordinary receipt of £88,000 to contingencies reserve instead of crediting it to profit and loss account. Thus, in respect of the fourth year of the world crisis, they had trebled their dividend and had increased their reserves by a sum which exceeded the net profit of each of the two preceding years. In view of the fact that they were mainly engaged in the export of their manufactured products this was a noteworthy achievement at a time when international trade was decreasing in volume. The value of orders received in 1933 was greater than that of the orders obtained in 1932, and contracts were concluded for the supply of all types of wireless plant, including broadcast transmitters, naval, military and aircraft apparatus, and telegraph and telephone stations to forty-five countries in all parts of the world. More than four-fifths of these orders, reckoned in value, were obtained in competition with foreign companies. Their engineers were engaged in erection work in most European countries and in Asia, Africa and South America. In the course of the year they put on the market twenty-one new types of wireless apparatus. The contract price of manufacturing work in hand on December 31st was £921,000. The research section which dealt with problems of broadcast reception was enlarged at the beginning of the current year. There was increased activity in all their research and development departments. Their broadcasting transmitters, embodying the floating carrier system, were in ever-increasing demand. In the course of 1933, 720 patent applications were ordered to be filed and the total number of patents and applications on their books on December 31st was 6,221. The chairman then referred to the Marconi-E.M.I. Television Co., Ltd., the registration of which was recorded in our last issue, page 749, and concluded by saying that they could look forward to a further development of the business in 1934.

Whitehall Electric Investments, Ltd., reports a net revenue for the year ended March 31st last of £263,883, as compared with £343,628 in the preceding year. A sum of £165,137 (against £159,009) is brought in, making £429,020, and after deducting the preference dividend it is proposed to carry forward the balance of £241,520. In 1932-33 an ordinary dividend of 3 per cent. was paid. The value of investments stands in the balance sheet at £10,318,176, after deducting capital reserve account £2,003,251; a valuation of these at March 31st gives an amount of £9,721,456. The directors have not made any provision against a contingent liability of a subsidiary company in respect of a participation of £248,863 in German advances subject to standstill arrangements. In Athens the electricity company has achieved a considerable increase in business during the past year; sales of power rose from 73,000,000 to 82,000,000 kWh and the number of consumers increased from 85,000 to 96,000. The drachma, however, has remained at a heavy discount in terms of sterling, and the financial results of the company have suffered in consequence. To compensate for this exchange factor an adjustment of tariffs has been put into effect.

In Spain the new hydro-electric plant at Izbor has been completed and placed in service. Sales of power during 1933 were slightly below those of the previous year, but progress has been made in connecting new consumers. The West of England companies continue to show steady progress. The companies' systems have been extended and sales of energy during 1933 reached 10,000,000 kWh. The $10,000,000 6 per cent. note of the South American Power Co. which the company acquired in 1929 matured on January 3th last, and as a result of negotiations 20 per cent. was paid in sterling at par. In satisfaction of the balance, the company has accepted a minority investment in an electrical undertaking and three sterling notes of the South American Power Co. for a total of £1,508,871 carrying interest at 6 per cent. per annum.

The Delhi Electric Supply & Traction Co., Ltd., held its annual meeting on May 29th, when Mr. K. A. Scott-Moncrieff (chairman), who presided, said that they secured 863 new consumers during 1933. Electricity sold increased by 7½ per cent., but the revenue increased by only 3½ per cent., due to reductions in charges. Further reductions had been arranged to take effect almost immediately. The tramways carried 22 per cent. more passengers and brought in 15 per cent. more revenue. They had arranged to introduce trolley buses which would be the first of this type in India. If the experiment was successful they hoped to see that system considerably extended.

The Dubilier Condenser Co. (1925), Ltd.—Presiding at the annual meeting held on May 29th, Sir Arthur Lowes Dickinson (chairman) in reviewing the report and accounts, said that business during 1933 was greater in volume, but approximately the same in value as last year. Technical research was being continued and production costs reduced. Competition had been very severe with consequent lower prices prevailing. Mr. F. H. McCrea, sales director, had been appointed deputy managing director.

The Edison Swan Electric Co., Ltd., reports a net loss for 1933, after providing for depreciation, debenture interest, &c., of £25,935, as compared with a net profit of £19,094 for 1932. A sum of £28,000 not required is transferred from tax reserve and added to £10,886 brought in, and after deducting the loss for the year the amount available is £12,951. The preference dividend absorbs £5,625, and £7,326 is carried forward. No dividend is paid on the ordinary shares, which in 1932 received 6 per cent.

The North Somerset Electric Supply Co., Ltd., was to hold an extraordinary meeting yesterday (Thursday) to consider a resolution to increase the capital to £600,000 by the creation of 100,000 ordinary £1 shares. These shares will be offered to ordinary shareholders in the proportion of one new share for every three held at 32s. 6d. per share.

The Anglo-Argentine Tramways Co.—A meeting of the 5 per cent. debenture stockholders will be held on June 5th to consider proposals for a temporary suspension of interest payments.

Ward & Goldstone, Ltd., have declared a dividend of 10 per cent. on the ordinary shares for the year ended March 31st last (against 7 per cent. for 1932-33).

Crompton Parkinson, Ltd., have declared an interim dividend on the ordinary and "A" ordinary shares at the rate of 6 per cent (unchanged).

Stocks and Shares

TUESDAY EVENING.

IT is a very long time since this column has had to start off with such a recital of depreciation in the share values of electricity supply companies as is the case this week. Practically every ordinary share in the group has been affected, either more or less. The falls range from sixpence to half a crown. For a time, on Monday, it became almost difficult to dispose of some, even of the leading issues. For this so unusual state of affairs nothing more tangible can be found in explanation than a fit of nerves, brought on by hints at possible adverse legislation in the electricity supply industry. Added to which there is, of course, the obvious fact that prices were standing very high, and that the yields on the money had dwindled to less than 4 per cent. So far as the possibility of legislation is concerned, there is nothing new in this. Everybody has known for some time past what is the position of the Central Electricity Board, and what are its aims. These latter have been regarded hitherto as corresponding with, rather than hostile to, the intentions of the supply companies. The mere hint, however, of a chance that the Board may endeavour to obtain control of certain of the companies, upon a valuation lower than that represented by the present market prices of the shares, has sufficed to bring in sellers, and to unsettle a market which, for several years past, has been one of the steadiest in the Stock Exchange.

A Four Per Cent. Yield

The tremors had the effect of bringing in investors who paid no heed to the jeremiads. Prices recovered to some extent, though on balance the falls, it will be observed by

reference to the list of share prices, have been widely spread. It will be readily understood that the offering of shares in two or three companies exercises a purely sentimental effect upon those in other concerns, the whole group being affected by the same set of conditions. Possibly the market for these shares had been somewhat vulnerable to an attack of nerves of this kind. Owing to the high prices which the shares had reached, the general tendency, as already mentioned here on more than one recent occasion, has been for investment to transfer a certain amount of its capital to shares in mining companies, on which a better rate of income can be obtained. The shake-out which has occurred in the market for electricity supply shares is hardly likely to proceed farther, in view of the obvious support which the present fall brought to light. At the lower level of prices the yield upon money invested in the ordinary shares at to-day's figures comes to a little over 4 per cent.

From the long string of falls in the prices of ordinary shares in the London and provincial electricity companies a rise of $\frac{3}{16}$ in Victoria Falls ordinary, to $6\frac{9}{16}$, stands out with the sharper prominence. Talk of a possible increase in the dividend is the mainspring of the buying.

London Passenger Transport Stocks

Firmness in the prior-charge stocks of the London Passenger Transport Board is offset by a fall of 2 points in the "C" stock to 76½. The estimates as to what dividend the stock is likely to receive in respect of the year now ending seem to be about 3½ per cent., though opinions differ a good deal on the point. It might be safer, perhaps, to look for no more than 3 per cent., seeing that this first dividend is little more than a preliminary payment, and can scarcely be regarded as a reliable guide to the earning capacity of the stock in years to come. The other gilt-edged issues in this group are fairly steady. The disposition is, however, for prices to yield a little ground as each substantial new issue of stock or shares is advertised. Central Electricity Board loans are unchanged on the week.

Cables and Wireless

The recent speech of the chairman at the Cables & Wireless meeting has aroused a degree of uneasiness in the minds of stockholders which has led to a good deal of realising on the part of the preference proprietors. The stock, which was quoted at 74 a week ago, has gone back to 66½ ex the dividend. It is tolerably apparent, now, that the concern was grossly over-capitalised when the amalgamation of the cables and the wireless companies took place, the fusion taking effect, it will be remembered, from the middle of 1928. It was unfortunate for the proprietors of the stocks that trade depression should have settled over the world two or three years later, emphasising the difficulty of earning sufficient money, on the enormous capital, to meet even the 5½ per cent. preference dividend. At the present time half this rate is being paid, nor did the chairman at the meeting hold out particularly bright hopes as to a resumption of the full service in the near future. The fall in the preference stock led to flatness in the two ordinary issues, and, for the same reason, Globe Telegraph & Trust ordinary shares have dropped 25s. to 9.

The lively dealings in Electrical & Musical Industries shares, caused by the impression that the company has jointly perfected a system of television which will be commercially profitable, have given way to a quieter phase, but keen interest is maintained in the possibilities of this new development.

Manufacturing and Equipment

Shares in the companies connected with the manufacturing branches are dull in sympathy with the tone in the industrial markets generally. The Edison Swan profit for 1933 was substantially lower than that for 1932. The report says that the company has felt the effect of acute trade depression. Associated Electrical Industries are 6d. lower at 17s. 9d.; the company controls the Edison Swan Electric. Henleys are ¼ lower at 5½. Siemens have dropped to 17s.; the chairman spoke with cautious hopefulness at the meeting. Electric Constructions at 12s. 6d. are $\frac{1}{16}$ down. General Electrics have eased off to 41s. 3d.

Miscellaneous Matters

Anglo-Argentine Tramway debenture stocks have fallen further, the 5 per cent. debenture being almost valueless. This is due to the recent report, with its melancholy recital of the present position of the undertaking. British Electric Traction preferred and deferred stocks are ex dividend. The Mexican stocks are steady at their previous prices. American industrials, after the prices had fallen still further, came into a little demand, apparently on behalf of the Wall Street bear brigade. American Telephone & Telegraph at 110½ is 2 points down, and Internationals at 12 are a point lower on the week. Brazilian Tractions are flat upon reports that disagreement has arisen between the company and the Brazilian Government with reference to the rates charged by the former.

An offer of 4½ million shares by United Steel Companies, Ltd., at 21s. 6d., made on the Tuesday in this week, was subscribed in five minutes. Babcock & Wilcox are lower at 40s. The rubber share market is depressed by reason of the disappointment felt at the failure of raw rubber to respond to the hopes of an early rise in the price.

Share List of Electrical Companies

Home Electricity Companies.

	Nom.	Dividend. 1932.	Dividend. 1933.	Price. May 29.	Rise or Fall.	Yield. £ s. d.
Bournemouth and Poole	1	15	15	73/9	−¼	4 2 5
Brompton Ordinary	1	7	7	34/6	—	4 1 2
Charing Cross Ordinary	1	7	7	34/6	−1/−	4 1 2
Chelsea	1	7	7	34/−	−6d.	4 2 4
City of London	1	7½	7½	35/−	−⅛	4 5 9
Clyde Valley	1	7	7	38/9	−¼	3 12 4
County of London	1	10½	10½	55/−	−½	3 16 4
Edmundson's 7% Pref.	1	7	7	34/−	—	4 2 4
Elec. Dis. Yorkshire	1	9	9	47/6	−⅛	3 16 0
Elec. Supply Corporation	1	11	11	73/9	−¼	2 17 9
Kensington Ordinary	1	7	7	35/−	—	4 0 0
Lancs Light and Power	1	7	7½	36/3	−½	4 2 8
London Electric	1	7	7	34/6	−1/−	4 1 2
Metropolitan	1	10	10	50/−	−½	4 0 0
Midland Counties	1	7	7	35/−	−½	4 0 0
Mid. Elec. Power	1	8	8	38/9	−¼	4 2 6
North Eastern Electric Ordinary	1	6	6	31/−	−½	3 17 5
Do. 7% Pref.	1	7	7	35/−	—	4 0 0
Northampton	1	10	10	53/9	−¼	3 14 3
Notting Hill 6% Pref.	10	6	6	14½	—	4 2 9
North Met. Elec. Ordinary	1	10	10	61/3	−¼	3 5 3
Do. do. 6% Pref.	1	6	6	31/6	—	3 16 2
St. James' and Pall Mall	1	7	7½	36/6	—	4 3 4
Scottish Power	1	8	8	38/9	−⅛	4 2 6
South London	1	7	7	37/−	—	3 15 9
Westminster Ordinary	1	7	7	34/6	—	4 1 2
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	21/−	−1/−	7 2 10
Yorkshire Elec.	1	8	8	46/3	−¼	3 9 3

Public Boards.

		1931.	1932.			
Central Electricity, 1950–70	Stock	5	5	116	—	4 6 2
Do. 1955–75	,,	5	5	117	—	4 5 6
Do. 1951–73	,,	4½	4½	111	—	4 1 1
Do. 1963–93	,,	—	3½	97	—	3 10 8
London & Home Counties, 1955–75	,,	4½	4½	110	—	4 1 10
London Passenger Transport, A	,,	—	4½	119½	—	3 15 4
Do. do. B	,,	—	5	123½	—	4 1 0
Do. do. C	,,	—	—	76½	−2	—
West Midlands Joint Elec. 1948–68	,,	—	5	114	—	4 7 9

Telegraph and Telephones.

American Tel. & Tel.	$100	9	9	110½	−2	8 3 0
Anglo-Am. Tel. Pref.	Stock	6	6	115	—	5 4 5
Do. Def.	,,	1½	1½	28	—	5 7 2
Cables & Wireless 5½% Pref.	,,	2¾	2¾	66½xd	−5½	4 2 8
Do. A. 7½% Ord.	,,	Nil	Nil	16	−3	—
Do. B. Ord	,,	Nil	Nil	7	−1½	—
Globe Tel. and T. Ord.	10	Nil	2½	9	−1⅛	2 15 6
Do. do. Pref.	10	6	6	12½	−½	4 13 4
Great Northern Tel.	10	20	20	40	—	5 0 0
Marconi-Marine	1	10	7½	31/3	—	4 16 0
Oriental Telephone Ord.	1	12	12	3½xd	+⅛	*3 16 10

Home and Foreign Trams, Etc

Anglo-Arg. Trams First Pref.	5	Nil	Nil	1/6	−6d.	—
Do. do. 2nd Pref.	5	Nil	Nil	1/6	—	—
Do. do. 5% Deb.	Stock	Nil	Nil	3	−2	—
British Electric Traction Df. Ord.	,,	5	5	605xd	—	—
Do. do. Pref. Ord.	,,	8	8	157½xd	+3	5 1 7
Brazil Traction	100	—	—	9¼	−1¼	—
Brit. Columbia Elec. Rly. Pfe.	Stock	5	5	105	—	4 15 3
Mexico Trams, 5% Bonds	—	5	5	24½	—	20 8 0
Mexican Light Common	100	Nil	Nil	8	—	—
Do. 7% Pref.	100	7	7	7½	—	—
Do. 1st Bonds	—	5	5	49½	—	10 10 6
Victoria Falls Ord.	1	15	20	6⅝	+⅜	3 1 0
Yorkshire (West Riding)	1	2½	5	23/9	—	4 4 0

Manufacturing Companies.

Assoc. Elec. Ord.	1	4	3	17/9	−6d.	3 7 7
Do. Pref.	1	8	8	32/6	—	4 18 6
Babcock & Wilcox	1	9	6	2	−⅛	3 0 0
British Aluminium Ord.	1	5	5	30/−	—	3 6 8
British Insulated Ord.	1	15	15	68/9	—	4 7 3
Brush Ord.	Stock	Nil	Nil	35	—	—
Callender's	1	15	15	3⅛	—	5 0 0
Do. 6½% Pref.	1	6½	6½	30/9	—	4 4 6
Crompton Parkinson Ord.	5/-	22½	12½	27/−	—	—
Do. 8% Pref.	1	8	8	32/6	—	4 18 6
Edison-Swan 1st Pref.	1	7½	7½	24/6	—	6 2 5
Do. 5% Deb.	Stock	5	5	102½	—	4 17 7
Electric Construction	1	Nil	Nil	12/6	−⅛	—
Enfield Cable Ord.	1	25	20	86/3	—	4 13 0
English Electric	1	Nil	Nil	6/3	—	—
Do. do. Pref.	1	Nil	Nil	10/−	—	—
Ever Ready	5/-	35	35	29/6xd	—	5 18 8
Ferranti Pref.	1	7	7	27/−	+6d.	5 3 9
G.E.C. Pref.	1	6½	6½	31/3xd	—	4 3 2
Do. Ord.	1	8	8	41/3	−⅛	3 17 8
Henley's	1	30	30	5⅝	−¼	5 1 0
Do. 4½% Pref.	5	4½	4½	5½	—	4 5 9
India-Rubber Preferred	1	—	—	17/6	—	—
Johnson & Phillips	1	5	5	23/3	—	4 6 0
Siemens Ord.	1	6½	4	17/−	−1/9	4 14 2
Telegraph Construction	£1	Nil	Nil	21/3	—	—

* Dividends paid free of Income Tax.

Published Specifications

Compiled expressly for this journal by a firm of chartered patent agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings will be taken.

1932

21426. "Electric cables." Okonite-Callender Cable Co., Inc. July 29th, 1931. (409678.)

21880. "Electric lighting systems." General Electric Co., Ltd., B. Davis, G. Ellis and H. J. Coates. August 4th, 1932. (409711.)

22420. "Polyphase rectifiers." Akt-Ges. Brown Boveri et Cie. August 10th, 1931. (409759.)

24334. "Synchronous motors, particularly adapted for use with time-indicating mechanism." Eltime Clock Co. December 8th, 1931. (409697.)

24393. "Illuminated signs and the like devices." W. G. Bailey. September 1st, 1932. (Cognate application 22185/33.) (409712.)

26589. "Voltage regulation of alternating-current systems." Ganz es Tarsa Villamossagi Gep Waggon es Hajogyar Reszvenytarsasag. September 24th, 1931 (Addition to 322500). (409656.)

27215. "Electric converting apparatus." British Thomson-Houston Co., Ltd. October 1st, 1931. (409698.)

27218. "Electric converting apparatus." British Thomson-Houston Co., Ltd. October 1st, 1931. (409682.)

27310. "Electric converting apparatus." British Thomson-Houston Co., Ltd. October 1st, 1931. (409713.)

27324. "Electrical musical instruments." L. Mellersh-Jackson (O. Vierling). October 1st, 1932. (409684.)

27442. "Electric converting apparatus." British Thomson-Houston Co., Ltd. October 1st, 1931. (409734.)

27447. "Fusible electric cut-outs." British Thomson-Houston Co., Ltd., H. E. Cox and L. Drucquer. October 3rd, 1932. (409714.)

27723. "Wireless receiving apparatus." L. L. De Kramolin. October 6th, 1931. (409737.)

30010. "Electric filter circuits." Telefonaktiebolaget L. M. Ericsson. October 30th, 1931. (409660.)

30137. "Switch-operating mechanism particularly for electric motors." Leland Electric Co. March 31st, 1932. (409701.)

30180. "Control apparatus employing tooth and pawl mechanism." International General Electric Co., Inc. October 27th, 1931. (409685.)

30341. "Variable electric resistances or potentiometers." Steatit-Magnesia Akt.-Ges. May 12th, 1932. (409740.)

30408. "Electrical warming and lighting radiators." J. S. Beard. October 29th, 1932. (409686.)

30737. "Spools or reels used for holding cable such as electric cable or flex." F. W. Chambers. November 1st, 1932. (409668.)

30746. "Electric protective arrangements for polyphase electric circuits." A. Reyrolle & Co., Ltd., and H. Leben. November 1st, 1932. (409669.)

30749. "Telegraph, telephone or like exchange systems." Standard Telephones & Cables, Ltd. June 17th, 1932. (409670.)

30872. "Electric motor control devices." Igranic Electric Co., Ltd. November 2nd, 1931. (409720.)

30884. "Vapour-electric convertors." General Electric Co., Ltd., and E. Gallizia. November 2nd, 1932. (Cognate application 19742/33.) (409721.)

30890. "Magnet cores for use in loading-coils or the like." Automatic Electric Co., Ltd., and P. N. Roseby. November 2nd, 1932. (409691.)

30916. "Thermionic valves." P. Freedman. November 2nd, 1932. (409693.)

30920. "Electric insulators." Bullers, Ltd., and G. Perrins. November 2nd, 1932. (409694.)

31145. "Electric ignition systems." British Thomson-Houston Co., Ltd., and L. Griffiths. November 4th, 1932. (409726.)

31866. "Remote control and/or supervisory systems." Automatic Electric Co., Ltd., T. R. Rayner, and P. F. Gunning. November 10th, 1932. (409776.)

31987. "Electric cables." Macintosh Cable Co., Ltd., and A. Sargent. November 12th, 1932. (409780.)

32223. "Electrical measuring instruments." E. C. Ansell. November 15th, 1932. (Cognate application 31411/33.) (409784.)

32457. "Electric spot-welder." J. S. Rohan. November 17th, 1932. (409789.)

32871. "Electric insulating materials." British Thomson-Houston Co., Ltd. November 20th, 1931. (409802.)

33514. "Fitting for use in making connection between an electric cable and an electrical appliance." Callender's Cable & Construction Co., Ltd., and S. J. Bryce. November 26th, 1932. (409811.)

35858. "Electro-responsive systems for use particularly for protective purposes." A. S. Fitzgerald. December 17th, 1931. (Addition to 407745.) (409823.)

36570. "Pliers for cutting the insulation on electric cables." G. W. Hewitt. December 24th, 1932. (409830.)

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805. "Automatic circuit-breakers, switches, and the like in which thermally sensitive release devices are used." J. A. Crabtree. January 10th, 1933. (409842.)

1336. "Insulation of dynamo-electric machines." English Electric Co., Ltd., and W. E. M. Ayres. January 14th, 1933. (409846.)

1884. "Electrically heated cooking apparatus." W. H. S. Chapman. January 20th, 1933. (409850.)

1987. "Protective coverings on electron-discharge tubes." B. Erber and A. Schwitzer (trading as G. Ganz & Co.) February 3rd, 1932. (409851.)

3208. "Telephone cables." Siemens Bros. & Co., Ltd., and A. E. Foster. February 2nd, 1933. (409858.)

3711. "Direct-current generators." W. Sykes. February 7th. 1933. (409862.)

7990. "Road-traffic-control systems." British Thomson-Houston Co., Ltd., and J. H. Cansdale. March 16th, 1933. (409877.)

9743. "Electron-discharge devices." British Thomson-Houston Co., Ltd. March 31st, 1932. (409887.)

10810. "Electric furnaces." C. E. Cornelius. April 11th, 1933. (409893.)

13915. "Alternating-current interrupters." Siemens Schuckertwerke Akt.-Ges.—May 14th, 1932. (409904.)

14671. "Removable false end caps or adapters for electric lamps." L. Guicherd and A. Laribe. May 20th, 1932. (Cognate application 14672/33.) (409906.)

17087. "Electric time switches." E. Paulitschek. June 25th, 1932. (409917.)

18834. "Electric boiling plates." R. Haddan (Moffats, Ltd.). July 3rd, 1933. (409927.)

18917. "Locking means for electric lamps and other devices." F. F. Ray. July 22nd, 1932. (409929.)

21172. "Arc-extinguishing devices for electric switches." British Thomson-Houston Co., Ltd. July 27th, 1932. (409944.)

21502. "Method of temporarily reducing the total voltage across two or more series-connected rectifier groups for use with a radio transmitter." Akt-Ges. Brown Boveri et Cie. December 17th, 1932. (409947.)

21855. "Electric incandescent lamps of tubular form." H. Mayer. December 10th, 1932. (409953.)

22161. "Art of electric-arc welding." W. R. Hume and Hume Steel, Ltd. August 8th, 1933. (409955.)

22207. "Assembly of electric wires or conductors." A. E. Hirst and J. Compton Organ Co., Ltd. August 8th, 1933. (409956.

23063. "Control and protective arrangements for electric distribution systems." Westinghouse Electric and Manufacturing Co. August 25th, 1932. (409962.)

23086. "Operation of gas-blast electric switches." British Thomson-Houston Co., Ltd. August 20th, 1932. (409963.)

24220. "Television receiving systems." T. Nakashima and K. Takayanagi. December 12th, 1932. (409970.)

24493. "Electrode arrangements for electric-arc convertors." E. Marx, H. Buchwald and G. Krahl. September 3rd, 1932. (409974.)

25912. "Thermionic oscillation generator arrangements suitable for use in radio transmitters and the like." Marconi's Wireless Telegraph Co., Ltd. October 15th, 1932. (409986.)

26498. "Metal tube, particularly for locating electrical conductors." Power Flexible Tubing Co., Ltd. (Akt-Ges. O., Meyer-Keller et Cie). September 26th, 1933. (409991.)

27916. "Electrically driven rollers." Siemens-Schuckertwerke Akt-Ges. October 10th, 1932 (Cognate application 27917/33). (410007.)

28265. "Manufacture of mixed hologenated compounds for use as dielectric media." Telegraph Condenser Co., Ltd., and F. C. Stephan. October 12th, 1932. (410008.)

30128. "Sound transmitters." Echometer Ges. November 2nd, 1932. (410012.)

30529. "High-speed electrically-driven portable drilling and like tools." R. Bosch Akt-Ges. December 10th, 1932. (410015.)

30774. "Method and circuit-arrangement for keeping constant an electric current." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 18th, 1932. (410017.)

31151. "Electric discharge tubes." Steatit-Magnesia Akt-Ges. November 23rd, 1932. (410019.)

31825. "Television and like apparatus." Fernseh Akt-Ges. November 18th, 1932. (410023.)

33426. "Dynamo-electric machines." English Electric Co., Ltd., A. D. Sloan and F. A. Youngmark. November 29th, 1933. (410035.)

34475. "Electrical time-signalling systems." S. Citterio. July 9th, 1932 (Divided application on 19417/33). (410039.)

36382. "Method of transmitting signal currents through telephone lines." S. G. S. Dicker (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). December 27th, 1933. (410051.)

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2883. "Superheterodyne radio receivers." L. L. de Kramolin. October 6th, 1931 (Divided application on 27723/32). (409756.)

3441. "Lamps." R. Bosch Akt-Ges. February 10th, 1933. (410063.)

4041. "Electric motors." British Thomson-Houston Co., Ltd. February 7th, 1933. (410064.)

5050. "Electric motors." British Thomson-Houston Co., Ltd. September 16th, 1933. (410065.)

9807. "Fittings for use in making connection between an electric cable and an electrical appliance." Callender's Cable and Construction Co., Ltd., and S. J. Bryce. November 26, 1932 (Divided application on 33514/32). (410072.)

Trade Mark Applications

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from May 23rd :—

Mattelyte. Nos. 550118 and 550119. All goods in Classes 5 and 14.—Johnson, Matthey & Co., Ltd., 73-82, Hatton Garden, E.C.1.

Rhino. No. 549196. Class 8. Telegraphic and telephonic and radio telegraphic and telephonic instruments and apparatus, and parts thereof, electricity meters and measuring instruments, electrically operated cinematograph apparatus, electric lamps for scientific purposes, electrically operated speed, distance and pressure indicators, rheostats, electric signalling apparatus, accumulators and batteries, &c.—General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.

Croxa. No. 550222. Class 13. Battery terminals and cable connections made of ordinary metal.—F. W. Berry and L. G. T. Hunns, trading in co-partnership, 35, Beech Hall Crescent, Highams Park, Chingford, E.4.

Pylon. No. 550149. Class 18. Electrical heating apparatus.—Premier Electric Heaters, Ltd., Keeley Street and St. Andrews Road, Birmingham.

Anka. No. 548128. Class 50. Insulating parts of electrical connectors made principally of asbestos, mica or pitch or from compositions having a basis of synthetic resin, cellulose derivatives, casein, a natural resin or of bitumen.—Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, E.C.4.

New Work for Contractors

Particulars of new works and building schemes for the use of electrical installation contractors and traders

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Barnsley.—Houses (1,215); borough surveyor.

Bedfordshire.—Senior school, Dunstable, for County E.C.; director of education, Bedford.

Billingham-on-Tees.—Cinema and shops, Wolviston Road, for the Picture House (Billingham), Ltd.

Birkenhead.—New Emporium for the Co-operative Society; W. Tomkinson & Sons, builders, 3, Great Newton Street, Liverpool.

Birmingham.—Catholic church, Yardley Wood Road, Billesley (£20,000), with electrical work; Bernard Cox, architect, 109, Colmore Row.

Blandford.—Cinema, East Street, for P. H. Carter, Palace Cinema.

Blaydon-on-Tyne.—Houses (156), Blaydon Bank; V. Mastaglio, U.D.C. surveyor.

Boston.—Cinema, West Street, for Boston Scala Theatre, Ltd.

Bournemouth.—Senior school, East Howe; borough engineer. Senior department to Stourfield Council School (£11,777); Wm. Potter & Son.

Bredbury and Romiley.—Houses (300), Romiley; W. G. West, builder, 4, Wellington Road South, Stockport.

Bridlington.—Senior boys' school (£17,000), for Borough E.C.; Jacques & Greeves, Ltd., builders.

Brighton.—Houses (35), Bunkers Hill; borough engineer. Houses (60), Dale Crescent Estate; Braybons, Ltd. Cinema, Hotel Metropole, King's Road; Gordon Hotels, Ltd. Premises for Lloyds Bank, Ltd., London Road (£14,198); Building & Public Works Construction Co., Ltd.

Broadstairs.—Cinema, Chandos House site; Gaumont-British Picture Corporation, Ltd., Denman Street, London, W.

Bromley (KENT).—Houses (88), Pickhurst Lane, for H. F. Thoburn, Ltd.

Brownhills (STAFFS).—Houses (76); U.D.C. surveyor.

Brynmawr.—Houses (52), Twyncynghordy; U.D.C. surveyor.

Buckinghamshire.—Schools, Chalfont St. Peter (£16,320), and Slough (£40,000), for County E.C.; director of education, Aylesbury.

Burton-on-Trent.—Rebuilding, Opera House, George Street (£10,000), with electrical work; T. Jenkins, architect, 3, Lichfield Street.

Bury St. Edmund's.—Houses (40), electrical work, Prior's Road Estate; Building & Public Works Construction Co., builders, Swindon.

Cannock.—Houses (150), Belt Road, Hednesford, for A. J. Pace.

Carlisle.—Bus station for Blair and Palmer; H. Foxall, architect, 54, Lowther Street.

Chatteris.—Cinema, Park Street, for Chatteris Amusements, Ltd.; Ward & Woolnough, architects, Wisbech.

Colchester.—Isolation hospital pavilion (£19,500); city surveyor.

Colne (LANCASHIRE).—Offices for Colne Building Society, 61, Market Street (£10,000), with electrical work; Holgate & Spivey, architects, 4, Dockray Street.

Cottingham.—Houses (60), Friary Road (£19,000); F. Bilton, 87, Wincolmlee, Hull.

Coventry.—Elementary school, Canley Housing Estate; E. H. Ford, borough surveyor, the Council House.

Croydon.—Houses (92), Ham Farm (£30,229); M. J. Gleeson, Ltd., Sheffield. Sewage works with electrical works; borough engineer.

Derbyshire.—School (350 places), Frecheville, Beighton, for County E.C.; director of education, Derby. Secondary school, Tupton Park, for County E.C.; G. H. Widdows, county architect, County Hall.

Devonshire.—Grammar school, Bideford, for County E.C.; county architect, 97, Heavitree Road, Exeter.

Doncaster.—Public offices (£10,261); Walter Firth, Ltd., builders, Lockwood Road.

Droylsden.—Houses (140) and shopping centre, Grenoside Lane; A. Bottomley, builder, 34, Lakeside Avenue, Great Lever, Bolton.

Dukinfield.—Houses (80), Park Road, Sandy Lane and Towe Street, Tame Valley; F. Wetton, The Gables, 41, Argyle Street, Blackpool.

Dunfermline.—Houses (14), Balderidgeburn; James Scott & Co., Chapel Street.

Dunstable.—Houses (60), High Street, for H. C. Janes, Ltd., Luton.

Epsom.—Houses (200), Ewell Court Estate; Workmen's Housing Association (1933), Ltd.

Farnham (SURREY).—Hospital (£10,825); Mardon Ball & Co., builders.

Freshwater.—Cinema, for Isle of Wight Theatres, Ltd.

Gateshead (DURHAM).—Catholic church (£7,000) with electrical work; R. Burke, architect, 12, Grey Street, Newcastle-on Tyne.

Glasgow.—Houses (54), Garscube Road, and 351 houses, Bilsland Drive; housing director. Workshops, &c., Castle Street (£22,500); S.W. Scotland Joint Committee for Blind Welfare. Staff houses for three hospitals (£12,000), and reconditioning, Hutchesontown Baths (£15,000); city engineer.

Greenock.—Building, Watt Memorial Engineering and Navigation School (£15,000); Boston, Menzies and Morton, architects.

Grimsby.—Two schools, Yarborough Road and Macaulay Street, for E.C.

Halesowen (BIRMINGHAM).—Houses (91), Alexandra Road, Hawe; C. Byng, builder, St. Kenelms Avenue, Hasbury.

Hertfordshire.—School, East Barnet Valley (£20,926), and grammar schools, Cheshunt and Barnet, for County E.C.; director of education, Hertford.

Herefordshire.—Conversion of mansion into mental home (£17,739)), for C.C.; clerk, Hereford.

Herne Bay.—Houses (350), Greenhill Grove Estate; Messrs. Carters. Post office, for H.M. Office of Works, King Charles Street, London, S.W.

Hexham.—Houses (80), Bog Acre; H. E. Pitt, Ltd., builders, Millfield, Sunderland.

Irish Free State.—(CASTLEREA, Co. ROSCOMMON).—Mental hospital, Harristown, for the Committee of Management; J. R. Boyd Barrett, chartered architect, 61, South Mall, Cork. (SLIGO).—Houses (100), Knappagh housing area site, No. 3; McDonnell, Dixon & Downes, architects, 20, Ely Place, Dublin.

Isle of Axholme.—Houses (100); R.D.C. surveyor.

Jarrow-on-Tyne.—Houses (160), for slum scheme; borough engineer.

Knottingley.—Houses, Ferrybridge Road: J. G. L. Poulson, architect, 25, Ropergate, Pontefract.

Lancashire.—Senior school, Prestwich, for County E.C.

Leicester.—Isolation hospital, extensions (£40,120), for the Health Committee. Extensions to factory, London Street; C. C. Ogden, architect, 42, Silver Street. Rebuilding of the Borough Theatre, Hinckley, as a cinema (£12,000); H. Robinson, architect, Cadogan Chambers, Cherry Street, Birmingham.

Little Thurrock (ESSEX).—Houses (61), Lawn Field Estate, for Harvey & Doughty.

Liverpool.—Houses (712), Huyton-with-Roby; city surveyor.

London.—Extensions to West London Hospital, Hammersmith Road (£32,000); secretary. (BATTERSEA).—Factory for Morgan Crucible Co., Church Road; Lewis Rugg & Co. (BERMONDSEY).—Flats (113), Mellicks Place (£57,929); borough engineer. (LEE).—Houses, Woodstock Estate; G. H. Builders, Ltd. (TOTTENHAM).—Houses (36), Council Estate (£10,338); M. J. Gleeson, Ltd., Sheffield. Factory and offices, Queen Street; L. Lazarus & Son, Ltd. Factory, Selby Road; Sir William Prescott. Factory, West Road; A. J. King, Ltd. Factory, Willoughby Road; Commercial Structures, Ltd. Library, Compton Crescent (£9,500); U.D.C. surveyor.

Longbenton.—Houses (70), Forest Hall; R. Carse & Sons, builders, Morpeth.

Luton.—Houses (500), High Street, Leagrave, for Leagrave Garden City (Luton), Ltd., 6, Broad Street Place, London, E.C. Maternity home (£24,700); borough engineer. Works extensions, Chaul End Lane, for Brown & Green, Ltd.

Manchester.—Houses (50), Clough Road, Moston; H. Hankinson, 3, the Downs, Altrincham. Houses (148), Styal Road, Heald Green; H. F. V. Newsome, architect, 2, Blue Board Court. Extensions to Institution for Board of Management of Babies' Hospital, Burnage Lane, Levenshulme (£10,000); J. Gerrard & Sons, Ltd., builders, Swinton. Extensions to Loreto Convent, Upper Moss Lane, Whalley Range, for the Catholic Authorities (£30,000); George MacFarlane & Sons, builders, New York Street, Chorlton-on-Medlock.

March.—Factory, March-Wisbech Road; British Farina & Dextrine Co., Ltd., 109, Kingsway, London, W.C.2.

Newcastle-on-Tyne.—Premises, Prudhoe Street, for Morris & Jones, Ltd. (£20,000); Marshall & Tweedy, architects, Pilgrim Street.

Nottinghamshire.—School for defectives, Mansfield, and centres, Radcliffe, Tuxford & Southwell; county architect.

Oldham.—Houses (50), Moors Housing Site, Chew Valley, Saddleworth; Buckley & Roseblade, builders, Shaw Street, Greenfield. Houses (160), Windmill Estate, Broadway, and 68 houses, Cloggerhill Estate, Birch Avenue and Abbey Hey Lane, Gorton, Manchester; Schofield & Thompson, builders, Hartley Street.

Paignton.—Houses (50), Barton Avenue; Coombe & Son.

Portland.—Cinema, Fortune's Well; Andrews & Andrews, architects.

Preston.—Houses (500), Ashton; Page & Taylor, Ltd., Preston Dock, Ashton.

Reigate.—Houses (100), Colesmead Estate, Redhill; G. G. Sanderson, borough engineer.

Ryton-on-Tyne.—Houses (50); Newcombe & Newcombe, architects, 23, Eldon Square, Newcastle-on-Tyne.

Southend-on-Sea.—Cinema, for the Astoria Co.; E. A. Stone, architect, 20, Berkeley Street, London, W. Factory for the St. Ann's Manufacturing Co., Ltd.; J. C. Flaxman & Sons, builders, 114, Southchurch Road. Factory extensions, Prittlewell, for E. K. Cole, Ltd.

Stockport.—Houses (234) and flats, Cheadle Heath; W. F. Gardner, borough surveyor. Houses (100), Halesden Road, near Manchester Road; Gough & Gurney, builders, Prudential Buildings, St. Petersgate.

Stocksfield (NORTHUMBERLAND).—Houses (60), Mickley Grange Estate; R. Gazzani & Son, builders, New Ridley Road.

Sutton.—Houses (68), Worcester Park; U.D.C. surveyor.

Tilbury.—Five-storey factory, East Tilbury; Bata Shoe Co.

Trowbridge.—Houses (134), Shail's Lane; U.D.C. surveyor.

Twickenham.—Flats (132), Jubilee Avenue and Meadway; G. Heath (Builders), Ltd. Senior schools for Borough E.C.; borough surveyor.

Tynemouth.—Houses (42), Billy Mill Estate; F. R. N. Haswell & Son, architects. Houses (216), Ridges Estate; L. W. Evans, builders, 23, Coniscliffe Road, Darlington. Ice factory, North Shields Fish Quay; J. L. Beckett, borough engineer.

Weetslade (NORTHUMBERLAND).—Houses (100); T. W. Burgess, U.D.C. surveyor.

Wigan.—Houses (400), Poolstock; J. Berry, Morton Grange, Aughton, near Ormskirk.

Windsor.—Houses (66), Church Farm site; F. N. McRae, borough engineer, 16, Alma Road.

Wolverhampton.—Houses (214), Low Hill Estate; John F. Hughes & Son, builders, Lichfield Street.

Woodford Halse (NORTHAMPTONSHIRE).—Cinema, Church Street, for G. A. Saville.

Worsborough (YORKS).—Houses (58), Cliffedale Crescent; T. Shield, U.D.C. surveyor, Saville House, Worsborough Bridge.